THURSDAY, JUNE 26, 1879

HISTORICAL SUN-DARKENINGS

NOT a few persons appear to have been much exercised by a prognostication emanating from an American source, whereby the public are forewarned of an approaching period of sun-darkening to extend over several days. History does record instances in which the sun has been abnormally obscured or its light paled to such an extent that stars have come into view in the daytime, and Erman, Humboldt, and other writers have brought these occasions into prominent notice, the former in connection with the presumed passage of dense meteoric streams between the earth and the sun. The earliest mention of such a phenomenon appears to be in the year B.C. 44, about the time of the death of Julius Cæsar, when we read in Plutarch and Dio Cassius that the sun was paler than usual for a whole year, and gave less heat, the air continuing cold and misty. The darkness for two hours on August 22, A.D. 358, appears to have preceded the great earthquake of Nicomedia. Two years later in all the eastern provinces of the Roman Empire we are told there was "caligo a primo auroræ exortu adusque meridiem," and the stars were seen, the further description being rather applicable to a total solar eclipse; but neither the eclipse of March 4, 360, nor that of August 28, would be visible in those parts. Again, when Alaric appeared before Rome, the darkness was such that stars were seen in the daytime (Schnurrer, "Chronik der Seuchen"). Following the *Tablettes Chronologiques* of the Abbé Lenglet Dufresnoy, Alaric invested Rome A.D. 409, and became master of the city on August 24, 410; there was a visible eclipse of the sun on June 18 of the latter year, therefore while the siege was in progress; but on calculating the circumstances under which it would be seen at Rome, introducing the latest lunar elements, it appears that little more than half the sun's disk would be covered at the greatest phase about 2h. 40m. P.M., and no sensible diminution of sun-light would be occasioned by the eclipse. In 536, 567, and 626 we find mention of long periods of diminished sun-light. Schnurrer records that in 733, a year after the Saracens had been driven back beyond the Pyrenees, consequent on their defeat at Tours, "the sun darkened in an alarming manner on August 19; there appeared to be no eclipse by the moon, but rather an interruption from some meteoric substance." There was an eclipse of the sun, annular but nearly total, on the morning of August 14; it is mentioned in the Saxon Chronicle, which tells us "the sun's disk was like a black shield." The near coincidence of dates suggests in this case a connection between the darkness and the eclipse. In 934, according to a Portuguese historian, the sun lost its ordinary light for several months, and this is followed by the doubtful statement that an opening in the sky seemed to take place, with many flashes of lightning, and the full blaze of sunshine was suddenly restored. In 1091, on September 29, not 21, as given in some of the translations of Humboldt's *Cosmos*, Schnurrer relates that there was a darkening of the sun which lasted three hours, and after which it had a peculiar colour which occasioned great alarm. In another place we read: "Fuit eclipsis Solis 11 Kal. Octob. fere tres horas: Sol circa meridiem dire nigrescebat": there was no visible eclipse at this time, and the November eclipse was central only in the southern parts of the earth. A century later, or in June, 1191, according to Schnurrer, the sun was again darkened, with certain attendant effects upon nature: here the cause is easily found; on June 23 there was a total eclipse, in which the moon's shadow traversed the continent of Europe from Holland to the Crimea; the eclipse was total in this country between the coasts of Cumberland and Yorkshire. Erman refers to a sun-darkening on February 12, 1106, which was accompanied by meteors, and we read in the cometographies that on the 4th, or, according to others, on the 5th, of February in this year a star was seen from the third to the ninth hour of the day, which was distant from the sun "only a foot and a half." Matthew Paris and Matthew of Westminster term this star a comet, and we may take it to have been the same which, later in the same month, was observed in China under the sign Pisces, and which at one time was supposed to have been identical with the great comet of 1680; this body, however, would not appear to have been sufficiently near the earth as, even on the assumption of a denser constitution than usual with comets, to account for a diminution of the solar rays, by its intervention. On the last day of February, 1206, according to a Spanish writer, there was complete darkness for six hours. In 1241, "five months after the Mongol battle of Leignitz," the sun was so obscured, and the darkness became so great, that the stars were seen at the ninth hour about Michaelmas. In this case, again, the darkness referred to was undoubtedly due to the total eclipse on October 6, of which Prof. Schiaparelli has collected a full account from the Italian writers. Lastly, in 1547, from April 23-25, Kepler relates on the authority of Gemma, "the sun appeared as though suffused with blood, and many stars were visible at noon-day." Schnurrer thought this phenomenon was what the Germans call an "Hohenrauch," notwithstanding the visibility of stars.

From the above brief summary of what have been considered abnormal sun-darkenings, we see that in several cases the diminution of light has been due to the ordinary effects of a total eclipse, while it is clear that there are no grounds in the historical evidence for any prediction of a period of darkness. The nervous in these matters, and it would really appear that such exist, may take consolation therefrom. J. R. HIND

SCIENCE AND AGRICULTURE

BRITISH agriculture, in most of its aspects, will come into prominent notice next week. The great show at Kilburn, coming as it does just now at a time of great depression for farming at home, ought to teach us some useful lessons. It should tell us that the days of rule of thumb, the days in which we did as our fathers did are over. New means, new methods, new materials, new economies, new crops, must be associated with wider views of what the world wants and with more precise knowledge of what our little islands can best supply.

If we study soils, manures, crops, live stock, implements, the after-treatment of farm produce, or the instruction of agriculturists and of labourers—in every direction we shall learn how beneficial has been, and may still be,

the influence of the scientific method upon the agricultural art.

Anlaysis of soils has not answered the questions put by its means exactly as we expected. But it has frequently shown us why, through excess or defect of some ingredient, certain lands were barren, and it has taught us how cheaply and thoroughly to remedy their sterility. Excess of decaying organic matter, of soluble salts, or the presence of ferrous salts, or of iron pyrites, these have been recognised amongst the curable ills of our soils. What is known as the *coagulation* of clay is now understood, so that we can often bring it about and thus render heavy lands workable at our will. The relations between the fungi inimical to our cultivated plants and the constituents of our soils being known we can now fight more hopefully against blight and mildew. What kind of exhaustion of soil is to be feared and how it can be remedied is now within our knowledge.

The development of the industry of artificial manures has been a very marked feature of the whole period of forty years during which our great Agricultural Society has been in existence. Farmyard manure has been relegated to its true place—no mean one, but one which has no longer the importance once attached to it. As 100 tons of ordinary dung and litter do not contain more than 1 ton (often less) of real manurial substance—potash, nitrogen, phosphorus pentoxide—one hundredweight of guano may frequently replace with advantage the usual dressing of farmyard manure applied to an acre. But while chemistry has searched out the constituents of manures, and recognised and determined the elements of fertility scattered in minerals and guano and waste products throughout the world, and shown how to bring all plant food into available forms, it has had also to carry on a perpetual warfare with the bands of adulterators, perfecting its methods of detecting the falsification of the materials which it has itself introduced; for manures are difficult to test by mere inspection, often being merely "dirts with a strong smell."

The improvement of existing varieties of plants by artificial selection has been carried to great perfection in many instances—the sugar-beet and wheat being notable examples. The introduction and improvement of new plants, both for cattle food and for the sustenance of man, is a work in which much remains to be done. Especially should attention be directed to those crops upon which lesser, but in many cases more, remunerative industries than mere corn-growing may be founded. Plants yielding products useful in medicine, dyeing, and perfumery, should not be neglected. Some districts on the Continent, such as the neighbourhood of Florence, have been immensely benefited in every way by the introduction of minor crops with their attendant industries; similar successes may be repeated where skill and capital are available, climate and soil being of course taken into account.

Of improvement in the breeds of horses, cattle, sheep, and pigs, nowhere can be found better illustrations than in England: we shall soon see how much our neighbours and friends abroad have gained from our work in this direction. In agricultural machinery and implements the same statement may be made with still greater emphasis: it is indeed curious to note how in every text-book of agriculture, in every farmer's journal, and rural advertisement published in France, Germany, Italy, and in most other countries both of the Old World and the New, the familiar names of Howard, and Fowler, and Cambridge, and Aveling, meet us on plough, and roller, and harrow, and engine. Perhaps in the after-treatment of some kinds of ordinary farm produce, we have been behind our Continental neighbours and American cousins, but we are beginning to appreciate better the aids that science can render to cheese and butter-making, and to the preparation of mill-products from wheat. The critical study of milk and dairy processes is securing the attention of dairy-farmers in England; while such an invention as Wegmann's porcelain cylinder for milling wheat has revolutionised the old grinding process already.

Of progress in the agricultural education either of farmers or farm-labourers, we have little to boast. Our solitary Agricultural College at Cirencester has been ever and anon paralysed by mismanagement; while its charges are too high, owing to the absence of any endowment, for its instruction to be accessible to the sons of ordinary farmers. Agricultural newspapers are neither as cheap nor always as instructive as they should be; the education in our elementary schools has hardly yet acquired that agricultural bias which in rural districts might be so advantageously given to it. Still the Science and Art Department has begun a good work by instituting its examination in the principles of agriculture, although its syllabus presupposes that the examinees will have been been fed on far richer and more varied stores of learning than are yet at their disposal.

This Kilburn Show will then direct our attention to a multiform subject of the greatest national importance at the present crisis. We shall hope to learn much from the exhibits in the eight miles of shedding arranged in due order over more than 100 acres of ground, and to be rewarded with over 13,000*l.* in prizes.

THE ELECTRIC LIGHT

THE Committee of the House of Commons appointed to inquire into the value of the electric light has completed its labours and has issued its report. There is no doubt that the evidence given before it, when published, will be very useful, and that the report itself is a careful digest of the facts elicited, but it is questionable whether the results of the inquiry, or the conclusions of the Committee, will satisfy any one. Our readers will find in it nothing new. Gas engineers will find in it their extermination calmly contemplated. The gas manufacturer is told that he has nothing whatever to do with electricity. Gas, and nothing but gas, is his ware. Though he was incorporated to illuminate a city with the then best known illuminant, he is not to touch a newer illuminant because he will check the development of the fresh source of light, and his present mode of production is quite different to that required for the new commodity. It is as though a wine merchant who had a large sale of sherry were not allowed to sell beer, or a dairyman were not allowed to sell asses' milk because he only kept cows. The enunciation of such a proposition in a Parliamentary Report is sad. Worse than all, municipal

authorities are advised that they can ruin all the gas interests without the distribution of any compensation whatever. Surely the enormous capital sunk by the public in gas enterprise deserves some consideration from its representatives in Parliament assembled. Are our vestries and corporations so immaculate that they are to have entire control of our supplies of water and of light? Why not give them the supply of food and of heat? The line must be drawn somewhere, and it is well that Parliament should hesitate in the complacency with which it now thrusts on irresponsible communities the distribution of vital necessaries.

The only sphere in which electricity has made itself useful and practical as an illuminant is in our lighthouses, and though it is eminently adapted for nautical purposes, as ordinary ships' lights, or to illuminate the sails of a ship, the Report is silent on the point and on the absurd restrictions which have been placed by the Board of Trade on its use at sea.

The statement that the energy of one-horse power when converted into gas-light only gives 12-candle power, and into electric light 1,600 candle power is startling if true. Without the evidence before us on which this statement is made we cannot well contravene it, but it seems based on some fallacy. We remember seeing somewhere, but cannot recall where, a somewhat similar estimate, but it was based on the assumption that the whole of the coal was consumed in producing gas, and no allowance whatever was made for the coke, tar, and other products of distillation. Is it so in this instance? Though 3 lbs. of coal consumed in one way may give one horse-power, and in another way 12-candle light, it by no means follows that one-horse power is equivalent to 12-candle gas-light—for in the case of gas we do not know the remanent energy.

The report fully confirms the opinion we have frequently expressed that the electric light sensation was due to a scare and not to any real progress or new discovery made. The transmission of power for mechanical purposes is foreign to the inquiry, and the suggestion that currents used by day for mechanical purposes can be used at night for illuminating purposes assumes what we only wish were true, that there is no mechanical work done in England in hours of darkness.

The general conclusion arrived at is that we can do no more with the electric light at present, but that we must do nothing to restrict its development. We did not require a Parliamentary Committee to tell us that.

INDIAN GEOLOGY

A Manual of the Geology of India. By H. B. Medlicott, M.A., and W. T. Blanford, F.R.S. Published by Order of the Government of India. (Calcutta, 1879.)

THE appearance of this long-promised work marks an epoch in the history of Indian science. In two moderate octavo volumes (paged as one) and the map which accompanies them, we have placed before us, in an attractive and convenient form, the matured conclusions of upwards of thirty years' systematic survey of the geology of our Indian possessions; and now, for the first time, the geological structure of India, or, at least, its leading facts, may be mastered by the student at no greater cost of labour than is involved in a few days' study of a well-arranged and thoroughly trustworthy manual.

We are reminded almost in the opening words of the preface, how many of those who have contributed to the researches on which this work is based, have now passed from among us. Stoliczka, J. G. Medlicott, the two Oldhams, Williams, and Loftus are only a few of the better known names among the many that for a longer or shorter time have been borne on the rolls of the Indian "Geological Survey," whose bearers lie in Indian graveyards, or beneath some modest tomb on the out-skirts of an Indian village, or who finally have returned with shattered health to the land of their birth, only to bring to a close among their friends the last few enfeebled months of their career. Of the earlier labourers in the field, of those who witnessed the birth of the "Geological Survey of India," and who three-and-twenty years ago wielded their hammers in breaking open the secrets of Indian rocks, but three still remain members of the Survey Staff, and to two of these surviving members whose names stand at the head of our article, we are indebted for the present masterly summary of the common labours of all.

The contributions of the two authors to the joint work are distinct, and in point of magnitude unequal. To Mr. W. T. Blanford has fallen the lion's share of the labour. Of the thirty chapters which (including the introduction) make up the work, Mr. Medlicott contributes ten, viz., those on the metamorphic and azoic rocks of the peninsula, and those on the geology of the Himálaya east of the Jhelum, and on Assam. The remaining twenty chapters, including the introduction, which deal with all the fossiliferous and neozoic rocks of the peninsula, the geology of Sind, the Punjab and Burma, and the Sivalik fauna generally, are the work of Mr. W. T. Blanford. The map,[1] which is printed in colours and is on the scale of sixty-four miles to the inch, has been compiled in the office of the Geological Survey, from materials in part unpublished. It professes to be only a preliminary sketch map, and three small tracts in the peninsula, the greater part of the Bikanir Desert and Guzerat, the Nepalese Himálaya, and Arakan and the adjoining hill tracts are left uncoloured. But with these exceptions it exhibits in as detailed a form as the scale admits of, and with unquestionable accuracy, the extent and boundaries of the several formations, classed as Alluvium, Upper and Lower Tertiary, Cretaceous, Jurassic, Triassic, Carboniferous, Silurian, Submetamorphic, Metamorphic, Granitic, Volcanic; and in the peninsular area, Upper and Lower Gondwána, and Vindhyan, the meaning of which unfamiliar and special classification we shall presently have occasion to notice.

The subdivision of the whole region into a peninsular and an extra-peninsular area is one of fundamental importance, and, as such, is treated in the arrangement of the manual. Geographically, the two areas are separated by the broad unbroken alluvial plain which stretches along the foot of the mountain zone from the mouths of the Indus to those of the Ganges; and geologically both in

[1] A copy of this map was sent for exhibition to the Great Paris Exhibition last year, but was probably seen by few. In fact, it was suspended in the office room of the Indian department, avowedly for want of room. Meanwhile a conspicuous case in the centre of the transept was devoted to the exhibition of Indian pickles.

history and structure, they present many strongly-contrasted features. In the words of one of the writers, "This [the extra-peninsular area] is geologically an intrinsic portion of the Asiatic continent, whilst peninsular India is not." For many years, indeed, it seemed that there was scarcely any stratigraphical link between the richly fossiliferous formations of Sind, the Salt Range, and the Kumaon Himálaya on the one hand, and on the other, the plant-bearing or azoic shales, and thick-bedded sandstones, described by Newbold, Williams, Voysey, Hislop, and others, which, with volcanic and metamorphic rocks, make up the greater part of the peninsula. While, with the exception of the later Himalayan and Sind tertiaries, the former are in the main of marine origin, a large portion of the latter are the characteristic deposits of fresh water; and, as regards the less ancient and fossiliferous formations, the apparently conflicting indications of age afforded by their fossil remains left it long impossible not merely to correlate them with any recognised members of the extra-peninsular formations, but even to assign to them with any confidence an approximate place in the general scale of geological sequence. Nor can this problem even now be considered as fully solved. But the scraps of evidence which, one by one, have been brought to light in the continued progress of the Survey have greatly simplified it, and this evidence is ably analysed and summed up in the first volume of the manual. The plant-bearing formations of the Peninsula are now regarded as one great system, to which the name Gondwána has been given, subdivided into an upper and lower series, and it represents the deposits of an ancient system of river valleys, dating from Permian and lasting to Tithonian times. The lesson in geological reasoning, inculcated by the geology of these rocks, is one that deserves to be carefully pondered, and in illustration of the difficulties which it presents, we will quote one or two passages from the fifth chapter of the Manual. To render the description more clear to the general reader we preface them with an excerpt from the tabular synopsis of the Gondwána formations at p. 108, exhibiting the accepted stratigraphical relations of the different groups referred to. It includes four only of the eight regions summarised in the original table.

	General Sequence.	Satpúra Region.	Godaveri Valley.	East Coast Region.	Cutch.
Upper Gondwána.	Cutch and Jabalpur	—	Chikiála	Tripetty	Umia
		Jabalpur		Sattavedu (?) ...	Katrol
	Rajmahal and Mahadeva	Bagra ...	Kota-Maléri ...	Ragavapuram and Sripermatur	—
		Denwa...		Golapilli	—
		Pachmari	—	—	—
Lower Gondwána.	Panchet ...	Almod(?)	Kámthi (including Mangli)	—	—
		Bijori ...		—	—
	Damúda ...	Motur ...		—	—
		Barákar.	Barákar	—	—
	Talchir ...	—	—	—	—
		Talchir..	Talchir	—	—

"[Dr. Feistmantel] ascribes to the whole series an age ranging from Lower Trias or Bunter (Talchír and Damúda) to Middle Jurassic or Bathonian (Jabalpúr and Umia). His determinations, however, being founded exclusively on a comparison of the Gondwána fossil plants with those of European formations, are very frequently opposed by other fossil evidence. The Umia beds of Cutch, for instance, the flora of which is considered by Dr. Feistmantel of the same age as that of the Jabalpúr group, which is the highest Gondwána subdivision, contains several plants found also in the Lower Oolites of Yorkshire, but the Cephalopoda of the marine beds, which immediately underlie the Umia plant beds, and are, to some extent, interstratified, have been shown by Dr. Waagen to be uppermost Oolitic (Portland and Tithonian) forms; and to be separated by two distinct groups of beds, each with a well-marked fauna, from the underlying strata, in which lower Oolitic Cephalopoda occur. In the Damúdas and their representatives, on the other hand, although a few fossil plants are allied to Triassic species, several of the most abundant and characteristic forms are unknown in the Trias of Europe, but are represented by the same or nearly allied plants in the coal measures of Australia, the lower portion of which is certainly of Carboniferous age." Again, "As an example of the difficulties presented in the present state of our knowledge by the contradictory evidence afforded by the fossils of one group, the case of the Kota-Maléri beds may be cited. The Kota beds consist of limestone, and contain remains of fish which have a liassic facies. The Maléri (or Malédi) beds have yielded two reptiles, *Hyperodapedon* and *Parasuchus*, and a fish, *Ceratodus*, all of which are closely allied to European triassic forms. In these Maléri beds some plants have been obtained common to the Jabalpúr and Sripermatur groups, the flora of the former of which has been shown to be in part identical with that of the Umia group of Cutch. The singularly contradictory evidence of age afforded by this Umia flora has already been mentioned. The Kota beds with their liassic fish have now been shown to be so closely connected with the Maléri clays and sandstones, containing triassic reptiles and fish and jurassic plants, that both are classed in the same group."

The conclusion which Mr. Blanford draws from this apparently conflicting evidence is the following:—

"Assuming that the association of similar marine forms in the rocks of distant countries—for instance in the Carboniferous limestone of Europe, the Punjab in India, and Australia,—implies that the rocks are of contemporaneous or nearly contemporaneous origin, the remarkable combination of fossils in the Kota-Maléri beds seems to show that, in mesozoic times, there was a wider diversity in the forms of terrestial life inhabiting distant regions at any given period than there was in the faunas of the surrounding seas. This view is in accordance with the very similar conditions now found prevailing upon the earth's surface, there being a much greater difference between the terrestrial faunas and floras of Africa, Australia, and America, for instance, than there is between the animals inhabiting the Atlantic, Indian, and Pacific Oceans. . . . . There appear, in short, good reasons for believing that the terrestrial area of the world was divided into zoological and botanical regions in past times as it is at present, and the fauna and flora of India may have differed at times, more from those then existing in distant countries, than from the animals or plants which prevailed in the same distant regions at a different geological epoch."

At the very base of the Gondwána system occurs that remarkable bed of silt containing transported boulders which is held by the authors, and we believe we may now say by all members of the Geological Survey of India, to afford evidence of the action of ice, probably ground ice; and it is not a little striking that the most conclusive evidence of this agency, viz., polished and grooved boulders resting on a surface of limestone equally polished and scored, was met with in latitude 20°, at an elevation of about 700 feet above the sea. The resemblance of this bed to that at the base of the Karoo formation of South

Africa, and indeed the palæontological and physical parallelism of the Karoo and Gondwána formations generally is now well known.

The peninsular area affords no instance of any fossiliferous rock of older date than the Gondwána system. But a large area to the north of Madras, another in Chhatisgarh, east of Nagpur, a third very extensive tract in Bundelkhand and Malwa, partly covered by trap, but still exposed over a surface of 40,000 square miles, and some smaller tracts in the valleys of the Kishna and Bhima rivers are occupied by a massive and quite unaltered series of sandstones, limestones, and shales of great thickness which have received the name of the Vindhyan System. From the fact that both in Bundelkhand and Hyderabad diamonds are found imbedded in these rocks, the name "diamond sandstone" was given by Capt. Newbold to a portion of these rocks, but the name was erroneously extended to the much later sandstones of the Gondwána formation, an error only cleared up by the labours of the Geological Survey. Beyond the fact that the Vindhyan system cannot be newer than Lower Palæozoic, nothing whatever is known of its age. Repeated search in the limestones and shales, however promising in appearance, has revealed no trace of any fossil organism, and it is impossible to correlate them with any group of rocks in the extra-Peninsular area, or, indeed, elsewhere. Below and older than these again, are two, or perhaps more, series of submetamorphic rocks, which, under various local names, have been mapped and described in many parts of the Peninsula, and all rest on the fundamental gneiss, which, whether of one or many ages, is everywhere the oldest rock, and is still exposed over nearly half the area.

The only remaining extensive formation of the Peninsula is the great Deccan trap-flow, the most extensive volcanic formation in the world. The age of this formation is now definitely fixed as Upper Cretaceous. Except in the neighbourhood of Bombay, where it dips with a gentle inclination beneath the sea, the successive flows are perfectly horizontal, occasionally interbedded with thin deposits of freshwater origin, and at one place, near Rajahmahendri, with an estuarine deposit. The area still covered by this formation is estimated at little less than 200,000 miles, and there are proofs of its former existence throughout nearly ten degrees of latitude and sixteen of longitude. For the discussion of the many interesting problems presented by this great manifestation of volcanic energy, we must refer the reader to the original work.

In passing from peninsular India to the encircling mountains we pass from an old continent to a new one, from a relic of a mesozoic land area, to the Asia of tertiary and post-tertiary times, and from a region where prolonged denudation has long since obliterated all but the merest traces of original mountain structure, leaving water-worn bosses of hard crystalline rock-cores or scarped slopes and sculptured platforms of horizontal trap or sandstone, to one where the latest deposits of tertiary times are so contorted and faulted as to render the task of disentangling the geological relations of the formations sometimes one of extreme difficulty.

The history of the Himálayan system, which, in addition to the Himálaya proper, includes the Indus ranges and those of the Burmese peninsula, begins in eocene times. It is considered by Mr. Medlicott that the very ancient slaty rocks which now form the greater part of the mountain mass south of the snowy range, and which he designates as the "Lower Himálaya," had undergone no contortion prior to the nummulitic period; and that immediately before its partial depression beneath the nummulitic sea, this area had been long exposed to denudation as "part of a land of doubtful configuration." It is still somewhat doubtful to what age are to be assigned the slaty formations here spoken of. As yet they have yielded no recognisable fossil remains, and they present no such similarity of character to the formations north of the main axis in Zanskar and Hundes, where rocks rich in fossil organisms have been described by Gérard, Strachey, Stoliczka, and others, as to allow of more than a speculative correlation. A recent observation of Mr. Lydekker's in the Pir Panjál range of Kashmir, throws however some little light on the question. The rocks of the slaty series extend in a north-west direction to the Pir Panjál range, and a limestone which there occurs at the top of the series, and appears to be identical with the Krol limestone (also the highest member) of the series near Simla, has been identified by Mr. Lydekker as Carboniferous. From this it would appear that rocks of mesozoic age are completely absent from the Lower Himálaya, and are restricted to certain areas north of the snowy range, and in the extreme north-west to certain parts of Kashmir, and we may add, the western extremity of the Salt Range.

Only in the Eastern Himálaya, viz., at the base of the Sikkim hills, have we any *indubitable* representative of the characteristic fresh water formations of the peninsula. In 1849, Dr. (now Sir Joseph) Hooker, detected some of the well-known fossil plants of the Bengal coal-bearing (Damúda) formation in certain shaley beds exposed at the foot of the hills near Pankabári, on the road to Darjiling, and this observation, subsequently followed up by Mr. W. T. Blanford, and more recently by Mr. Mallet, has led to the recognition of a band of Lower Gondwána rocks, occupying a narrow zone between the tertiary sandstones of the Terai and the talcose slates of the outer hills. The connection between the Eastern and Western Himálaya remains, however, to be traced out, the intervening kingdom of Nipál being unfortunately closed by the suspicious jealousy of its Hindu rulers, equally to the general traveller, the trader, and the man of science. It is however pointed out by the authors of the Manual, that the probably palæozoic slates, sandstones, and limestones of the Lower Himálaya were originally deposited on a highly eroded surface of ancient gneiss, and probably in hollows, and it is suggested by Mr. Blanford, that like the ancient unfossiliferous formations of the peninsula, they may be of freshwater origin, and that the Lower Himálaya may, after all, have formed a portion of the same palæozoic and mesozoic continent, around the shores of which were deposited the fossiliferous shales and limestones of Zanskár, Hundes, and the Western Salt Range, in which case the chain of the Himálayas must have originated along a portion of the ancient coast-line. And we may observe that the junction of the north and south ranges of the lower Indus valley with the north-west and south-east ridges of the Himálaya coincides in a general way with

the region where the palæozoic and mesozoic marine formations appear to the south of the Himálayan axis, the former in the Punjab and Afghanistan, the latter both there and further south, in Cutch, Sind, and Bálúchistán.

The geography of India in the early eocene period may be represented as something like the following:—The whole of the peninsular area was then, as it now is, land, with the exception of some portions of the present coast tract north of Bombay. In like manner the coast of Kaliwár and the greater part of Cutch were submerged, and a deep sea extended up the present Indus valley, and over Bálúchistán, also over the Punjab and parts of Káshmir, sending an arm up the present Ganges valley, which was in part estuarine, and bounded on the north by a tract of land composed of the then uncontorted rocks of the lower Himálaya. To the east of Bengal the present plain of Silhet and a part of the Khasi Hills were probably covered by a shallow sea, and this extended to the southward over Arakan and at least a large portion of Burmah.

It was in this state of things that the first great disturbance took place, which, repeated again and again during middle and later tertiary times, resulted in the present chain of the Himálaya. The river valleys which, after the first great upheaval, were carved out in the then youthful chain, discharged their stream-borne *débris* as now on the Gangetic plain; and the accumulated conglomerates, sands and clays, which formed around the mouths of the valleys, again and again suffered crushing and upheaval during the subsequent compression of the mountain mass, were added to the hills, and in their turn underwent erosion. But the valleys originally marked out have preserved their general course and function; and the Sutlej, the Bias, the Tous, the Jumna, and the Ganges, still flow out from the mountains along essentially the same lines of drainage which their then nameless representatives followed in miocene times. Such, at least, briefly stated, is the history which Mr. Medlicott and his colleagues have evolved during many years' study of these interesting rocks, first made famous through the classic labours of Cantley and Falconer, and by them named "Siwalik."

Not the least interesting chapter of the Manual before us is that in which Mr. Blanford deals with the rich and varied vertebrate fauna of these tertiary rocks. The original collections of Cantley and Falconer have been largely added to in later years by various members of the Survey; and a comparison of the forms obtained from different horizons in the Sub-Himálaya, the Punjab, Sind, Perim Island, and certain river valleys in the Indian peninsula and Burmah, has led to some modification of the opinions originally held of the geological age of the Siwalik rocks and their contained fauna.

As Mr. Medlicott has shown, the Siwalik rocks are an ancient alluvial formation, like the river fans described by Mr. Drew in Kashmir, and like the *Bhábar* deposits still forming along the foot of the Himálaya at the present day. In what may be termed the typical area, between the Sutlej and the Ganges, disturbances of some magnitude which took place after a portion of these deposits had been laid down, necessitate a subdivision of the series into three groups, upper, middle, and lower, the last of which is termed the Náhun group. It is from the two upper groups that (with perhaps some doubtful exceptions) all the fossils of this special region have been obtained, the Náhun group having remained unproductive to repeated search. An elaborate analysis of the homotaxis of the 45 mammalian genera (consisting of 84 species) which compose this fauna shows that the proportion of living to extinct genera is greater than in most miocene deposits. The presence of four extinct genera not known to range above the miocene period is contrasted with the occurrence of sixteen genera, not found elsewhere at a lower horizon than pliocene or post-tertiary; and there is a close approximation between some of the mammals and the living species of the same genera, the most remarkable of all being the connection of the fossil buffalo, *Bos palæindicus*, of the uppermost Siwalik strata, that of the post-pliocene Jumna and Nerbudda beds, and the Common Indian arnee still existing. Of six species of reptiles sufficiently well known to be comparable, three are common forms now inhabiting the same area, and the fresh-water mollusca also all apparently belong to common existing species. Putting the whole palæontological evidence together Mr. Blanford concludes that a balance is in favour of a pliocene age. This conclusion is strengthened by stratigraphical evidence. At the top of the enormous succession of tertiary deposits of Sind, which have a total maximum thickness of some 30,000 feet, occurs a group termed the Manchar group, about 10,000 feet thick, which is of fresh-water origin and represents the Siwaliks of Northern India. The lower beds of this group pass downwards into the Gaj group (1,000 to 1,500 feet thick), which is of marine origin, and contains a characteristic miocene fauna, "more probably upper than lower miocene." The Lower Manchar beds have yielded a considerable number of mammals, and this fauna, although containing several species in common with the Siwaliks, is altogether older in aspect; the majority of the forms hitherto recognised, belonging to the peculiar types of even-toed ungulates allied to *Nierycopotamus* and *Anthracotherium* intermediate in character between pigs and ruminants, and peculiarly characteristic of the miocene epoch. In these lower Manchar beds is also found a form of *Dinotherium*, a type unknown in the Siwaliks. Remarking that "there can be no reasonable doubt that the Manchar beds of Sind, as a whole, correspond with the Siwalik formation of Northern India, the two being portions of a continuous band of tertiary rocks," it is concluded that the fossiliferous lower beds of the Manchar group correspond to the unfossiliferous Náhuns, and the almost unfossiliferous Upper Manchar beds to the ossiferous strata of the Siwaliks. Mr. Blanford then remarks on the probable climatic causes which have preserved in the Indian pliocene an unusually large number of forms elsewhere characteristically miocene; and compares the case with that of the Pikermi beds in Attica, which are of unquestionable pliocene age. He considers that the general cooling of the north temperate zone at the end of the miocene period caused a migration of many of the characteristic mammals into Southern Asia, the Himálayan chain at that epoch not presenting so impassable a barrier as at the present day, and that such was the case seems to be confirmed by the occurrence of rhinoceros and elephant remains in the tertiary deposits of Hundes

at elevations now occupied only by the yak and similar mountain forms.

In reference to the greater richness of the Siwalik fauna, as contrasted with the Indian fauna of the present day, he quotes with approval the suggestion of Mr. Wallace, that a sweeping reduction was brought about by the cold of the glacial period. Of the influence of this cold in India, there are abundant proofs in the great extension of the Himálayan glaciers, for instance, in Sikkim and Kashmir, down to 6,000 feet and 8,000 feet above sea-level; and in the Naya hills of Assam, whose greatest elevation does not exceed 10,000 feet, in the large moraines at 4,500 feet, described by Col. Godwin Austen.

The oldest proofs of man's occupation hitherto met with in India, are a chipped axe or scraper, in the alluvial (post-pliocene) deposits of the Narbada, associated with remains of *Ursus*, *Elephas*, *Rhinoceros*, *Hippopotamus*, *Tetraprotodon*, and *Bos*, all of extinct species; and a flake, apparently of human manufacture, in the Godavari gravels of similar age. Quartzite implements of the palæolithic type are abundant in the laterite gravels of Madras, but these are probably of later date. Axes of neolithic type have as yet been met with only on the surface, most abundantly in the Banda district of the North-West Provinces.

The Manual is illustrated by twenty-one admirably executed lithographed plates of characteristic fossil forms, and a few woodcuts of sketches and sections. Its utility for purposes of reference is rendered all that can be desired by a copious and well-arranged index. We confidently hope that the publication of the work will give an impulse to the advancement of Indian geology by adding largely to the number of non-professional workers, a class which has hitherto been singularly wanting in India, despite the examples of such men as Carter, Forbes, Newbold, Strachey, and Hislop. H. F. B.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.*]

Prof. Clifford's Mathematical Papers

HAVING, at the request of Mrs. Clifford and Dr. Spottiswoode, undertaken the editing of the late Prof. Clifford's mathematical papers, I am anxious to secure the co-operation of all mathematicians who are interested in the matter. Prof. Clifford does not appear to have been in the habit of widely distributing copies of his writings, so I have found of many of them a great number of copies, whilst of others I have not come across a single one. I will first state what I have:—

All papers in the *Phil Trans.*, in the *Proceedings of the London Mathematical Society*, in the *Messenger of Mathematics*, in the *Manchester Transactions*, in the *Cambridge Philosophical Society's Journals*, in the South Kensington Handbook, in the *Mathematical Reprint* from the *Educational Times*.

Of the papers in the *Quarterly Journal of Mathematics* I have only §§ 1–11, 17–23, of the *Analytical Metrics*. I should be glad also to have a copy of the *Academy* for August 15, 1873, and information about "Lecture Notes" on Geometry. These last are lithographed and are comprised in twenty-six articles (? all), of which I lack one page, containing § 19–21. I need hardly add I shall be glad to receive any other papers (mathematical) which are not contained in the above-named journals. The NATURE article (translation of Riemann) I have. I have Mrs. Clifford's permission to distribute the author's copies of her late husband's papers to mathematicians who may wish to have them.

R. TUCKER

27, Cantlowes Road, Camden Square, N.W.

Pine-Pollen mistaken for Flowers of Sulphur

THE following paragraph appeared in the *Times* of June 16:—

"During the past week, after heavy rain, a thin film of sulphur has been observed at Windsor, Slough, and in the neighbourhood generally, to settle upon the surface of rain-water caught in butts and cisterns. The phenomenon at first did not attract much attention, but being observed on different occasions it has given rise to much speculation as to the cause of it, there being no manufactures in the neighbourhood at all likely to have produced it. It has been suggested that a sulphureous vapour may have been wafted to this country by the recent south-east winds, and arrested and deposited in the rain."

The supposed "sulphur rain," a fine yellow dust, was the cause of great excitement among the country people in this neighbourhood. It was first observed on the afternoon of Sunday, June 8, after a remarkably heavy shower, and much disturbed the inhabitants of some of the villages round Eton, who fancied that it smelt "awful like brimstone," of which its yellow colour was somewhat suggestive. In some places it gave rise to such a feeling of fright that the people were afraid to go to bed, thinking that the judgment day was at hand! Two or three days afterwards there was another "sulphur" shower, and I collected a quantity of the dust with my pupils, who were at work with me in my laboratory at the time. One of them, H. Bury, immediately recognised its resemblance to the pollen of *Pinus pinaster*, with which he is familiar from its abundance in the neighbourhood of his home at Bournemouth; and we have none of us any doubt but that this so-called sulphur is the pollen of this tree or of the Scotch fir, *Pinus sylvestris*, both of which are common in Windsor Forest. Two of the Windsor doctors, both practised microscopists, at once came to the same conclusion; but a local chemist and druggist is said (on good authority) to have supported the sulphur theory. This, perhaps, accounts for the rather positive statement by the Windsor correspondent of the *Times* as to the nature of the deposit, and also for the suggestion he refers to respecting its origin, which explains the phenomenon in a manner that is certainly more curious than probable, from a chemical point of view. I hear that the "sulphureous vapour" is supposed to have been "wafted to this country," after escaping from Etna during the recent eruptions, which fortunately occurred at just the right time to give apparent probability to the sulphur theory.

Thinking that such a remarkable phenomenon should not be allowed to pass unnoticed, I sent a short note to the *Times* of the 17th inst., stating the real (pollen) nature of the yellow dust, hoping that this would set the matter at rest and dispel the superstitious fears of the rustics. I was therefore greatly surprised, a few days afterwards, at receiving a letter from an F.R.G.S. residing near Carlow, in Ireland, who had seen my note in the *Times*, but nevertheless spoke of an "extensive fall of sulphur" in his neighbourhood. He was good enough to inclose me a "specimen of its incrustations" on a dead leaf, and said that "till yesterday's heavy rains any quantity of leaves like that I send you might have been gathered, and the edges of the pools of water were heavily incrusted with pure sulphur." He added that he thought I should not find the deposit to be "the produce of *Pinus pinaster*." This, of course, was rather startling, for I naturally supposed that no one would write so confidently who had not satisfied himself by chemical tests and by microscopical examination as to the truth of his statements, especially after hearing of the mistake which had been made in England. A glance at the deposit under the microscope, however, revealed its true nature—pine-pollen again!

I wrote accordingly to my informant, telling him this and sending him some pollen taken directly from the tree, so that he might recognise its similarity to the "pure sulphur" he so kindly sent me. I hope that by this time he has done so.

The above facts are of interest, partly as affording an excellent illustration of the transportation of pollen by the wind, and partly because they show how ready some people are to attribute an almost miraculous origin to anything a trifle out of the com-

mon, which could be readily explained by any one possessing a little elementary knowledge of science.

P. HERBERT CARPENTER

The Museum, Eton College, June 21

Intellect in Brutes

IN NATURE, vol. xx. p. 147, Mr. H. D. Barclay writes:—"The fact that a cat or a dog subject their food to examination before eating it, does not, most assuredly, prove the possession of abstract powers of thought in the animal. Mr. Romanes here says:—'The motive of the examination being to ascertain which general idea of quality is appropriate to the particular object examined.'

"Here he attributes to an animal whose nature he does not fully understand, his own process of thought, and this appears to me to be a constant source of error in the investigation of animal psychology. That brutes possess self-consciousness, introspection, imagination, abstract thought, cannot, I think, be proved. The fact that animals possess faculties differing from those of man is an insuperable obstacle to a perfect analysis of their intelligences.

"Name these faculties as you please, call them 'inherited habit,' 'inherited memory,' it is perfectly certain that man does not possess them."

Now, far from it being "perfectly certain" that animals possess mental faculties differing in kind from our own, it seems to me that, if we except the so-called "homing instinct" as a faculty about which as yet we know very little, it is "perfectly certain" that there is no other faculty presented by brutes which is not also presented by man. It is the converse proposition that is more difficult to combat—viz., that man possesses faculties of mind which appear at first sight to differ in kind from anything that is presented by animals. Therefore, while I should deem it almost superfluous to "prove" that man possesses "instincts" or "inherited habits" in common with animals, I have never attempted to "prove" that animals possess "self-consciousness" or "introspection" in common with man. Indeed, if Mr. Barclay will again read my article in NATURE, he will see that I expressly state my belief that these, the highest faculties of mind, may be, as the theory of evolution would lead us to expect they ought to be, confined to the highest product of psychological development.

As regards the illustration to which Mr. Barclay objects, I may observe that I selected it for the express purpose of disarming the criticism which he advances. Had I chosen for an illustration some "general idea of quality" more abstract than that of "good for eating or bad for eating," I could better have understood a critic accusing me of attributing to animals my "own process of thought" in the regions of self-conscious introspection. But seeing that I do not myself require or perform any process of introspective thought in order to reject a rotten egg or to regale myself on good roast beef, I cannot understand why I should not attribute to an animal precisely the same general ideas of "good for eating and bad for eating" that in my own case I know to be the causes of my acting precisely as I see animals act. The truth is that in speaking of general or abstract ideas we are not careful enough to discriminate between those simple ideas of quality which spring from mere sensuous associations, and those more elaborated ideas which spring from the more complex associations that are supplied by "mental reflection." But although it is of importance to remember that there is thus a great distinction between these two orders of abstract ideas, it is of no less importance to remember that both orders belong to the same class—all such ideas having reference to quality as abstracted from particular objects of perception, and the only difference between those of the one order and those of the other consisting in the higher degree of elaboration which is supplied to our abstractions by the power of thinking about our thoughts. On the whole, therefore, I maintain that it *can* be "proved" that animals "possess abstract thought" of the inferior order which I have explained, and the phenomena of dreaming which is presented by several animals would seem sufficient proof that some animals, at least, possess a tolerably well-developed "imagination."

GEORGE J. ROMANES

I HAVE been reading with great interest the letters and discussions lately published in NATURE, on intellect in brutes. However, in none of them have I found any notice of a dog recognising a painted likeness of his master or any member of the family. I have seen, in other publications on this subject, that "this is one of the things a dog has never been known to do." During my residence in Cornwall I had a most intelligent and faithful dog for fifteen years. I had him when a month old. His mother was a beautiful liver-coloured spaniel, rather large; his father a black Newfoundland; my dog took after him in colour and shape.

In 1843 a young and self-taught artist asked me to allow him to paint my likeness in oil colours, and I consented. His studio was in the next town, three miles distant, and as often as required I went over; I, however, did not take my dog with me. It was done in Kit-cat size; and he succeeded so well in the likeness and artistic work, that when exhibited at the annual meeting of the Polytechnic Society at Falmouth, a medal was awarded to it, and, as well, it was "highly commended." Not only this, it brought him into notice and gained him lots of employment. The artist was so grateful for my attention that he presented me with the painting, and I still have it. When it was brought to my house, my old dog was present with the family at the "unveiling;" nothing was said to him nor invitation given him to notice it. We saw that his gaze was steadily fixed on it, and he soon became excited, and whined, and tried to lick and scratch it, and was so much taken up with it that we—although so well knowing his intelligence—were all quite surprised; in fact, could scarcely believe that he should know it was my likeness. We, however, had sufficient proof after it was hung up in our parlour; the room was rather low, and under the picture stood a chair; the door was left open without any thought about the dog; he, however, soon found it out, when a low whining and scratching was heard by the family, and on search being made, he was in the chair trying to get at the picture. After this I put it up higher, so as to prevent it being injured by him. This did not prevent him from paying attention to it, for whenever I was away from home, whether for a short or long time—sometimes for several days—he spent most of his time gazing on it, and as it appeared to give him comfort the door was always left open for him. When I was long away he made a low whining, as if to draw attention to it. This lasted for years, in fact as long as he lived, and was able to see it. I have never kept a dog since he died, I dare not—his loss so much affected me. I might tell of many of his wonderful actions; he could do most of such things as are related of other dogs. I am now only anxious to notice this recognition of my likeness, from never having heard of another such fact being recorded of any other dog.

Edinburgh CHAS W. PEACH

A CASE somewhat similar to that mentioned by Dr. Frost, of a cat scattering crumbs, occurred here within my own knowledge.

During the recent severe winter a friend was in the habit of throwing crumbs for birds outside his bedroom window. The family have a fine black cat, which, seeing that the crumbs brought birds, would occasionally hide herself behind some shrubs, and when the birds came for their breakfast, would pounce out upon them with varying success. The crumbs had been laid out as usual, one afternoon, but left untouched, and during the night a slight fall of snow occurred. On looking out next morning my friend observed Puss busily engaged scratching away the snow. Curious to learn what she sought, he waited, and saw her take the crumbs up from the cleared space and lay them one after another on the snow. After doing this she retired behind the shrubs to wait further developments. This was repeated on two other occasions, until finally they were obliged to give up putting out crumbs, as Puss showed herself such a fatal enemy to the birds. GREENOCK

June 23

Aquarium Notes

Marine Copepoda—The lump-sucker.—In the salt water tanks of the Edinburgh Aquarium at the present date may be seen an immense number of white specks flitting rapidly through the water, after the fashion of the familiar *Cyclops* and its neighbours in fresh streams. On subjecting these "tenants at will" of the tanks to microscopic scrutiny, they are seen to belong to the Entomostracous division of the crustacea, and may in all probability be classified in the cyclops-family, as near kith and kin of the well-known "fresh-water flea." The cephalothorax

is well-defined, the body being flattened, whilst the posterior edges of the cephalothorax are prominent and somewhat hooked. The feet number five pairs, and are setose. No external ovisacs exist, and the antennæ are of simple conformation. Under the microscope the intestinal canal, filled with brownish matter, is seen to pulsate in rhythmical fashion. The abdomen is apparently composed of some four joints, and is terminated by two long caudal bristles. The eye is single, median, and red-coloured. In the absence of more definite characters, I should feel inclined to allocate the form near the genus *Alteutha*, of Baird, from the hooked character of the cephalo-thoracic edges. It differs from *Alteutha*, however, in the absence of the characteristic hooked edges of the fourth somite of the abdomen. The sudden appearance of myriads of these creatures in the tanks may probably be attributed to the recent favourable temperature; the eggs of the adults having lain dormant, as do the cyclops themselves, through the winter.

In the tanks are shown at present several large specimens of the lump-sucker (*Cyclopterus lumpus*). These fishes, as is well known, adhere by means of their sucker (formed by the modified ventral fins) to fixed objects. Watching a lump-sucker firmly attached to the glass of the tank, the idea occurred to me that the sucker may have been developed by natural selection, as a useful adjunct to the breathing-movements of the fish. When fixed, the fish appears to be perfectly at ease, and to breathe more fully and strongly than when swimming. The movements of the opercula, or gill-covers, when the fish was attached, were specially strong, as compared with their motion in the act of swimming. In a large-headed and heavy-bodied fish like *Cyclopterus*, any aid given to the respiratory movements would be a clear gain to the animal; and from a habit simply of resting on an object so as to afford leverage and play to the gills, the comparatively useless ventral fins may have become specially modified as a disc of attachment. The development of the sucking-disc and enlargement of the branchial cavity would thus proceed *pari passu*, and by natural selection the present exaggerated features of both organs would be attained. It would be interesting to know whether the history of cyclopterous development might or might not confirm these suggestions. The lump-suckers have spawned in our tanks, but unfortunately there has been no attempt on the part of the males to fertilise the ova.

Edinburgh, June 14 ANDREW WILSON

Snails *v.* Glow-worms

SOME years ago I brought three glow-worms from Wales to London, and at night I put them on the grass, when all showed their lights; but on looking for them a short time after, one had nearly disappeared, and on searching for it my hand came against something cold, and on taking it to the light I found it was a snail—one of those which just now are very common—about 1½ inches long by ¼ inch diameter, and of a sandy colour. The brute had swallowed the glow-worm, and I could see the light shining inside!

As there are no glow-worms in this part of the country, I wish some one who has the chance would try the experiment again, by placing a glow-worm and a snail near to each other, and report the result. R. S. NEWALL

Ferndene, June 22

Oxygenated Rain

THIS morning I have read Mr. Solly's note on this subject. Yesterday, June 21, we had a thunderstorm, and while looking at the lightning I noticed that the rain falling on the window-glass had what I first thought were small particles of hail in the drops; but on magnifying it I found that the opacity was caused by a number of very small air-bubbles, which soon disappeared.

These drops fell during the shower, and only for an interval which I think did not exceed ten seconds, for I had only time to take the magnifier out of my pocket and observe a few drops, after which no more fell which contained air-bubbles.

One flash of lightning left a track which lasted about five seconds, and gradually faded. This was also observed by one of my family who was observing at a distance of 1,000 feet from where I was. R. S. N.

Butterfly Swarms

THE swarms of butterflies alluded to in NATURE, vol. xx. p. 183, have been observed in various localities of Switzerland—Lausanne, Morges, the foot of the Jura, &c. The passage lasted a long time, from one to four hours, on June 9; the species was *Vanessa cardui*. By comparing the hours and dates of the appearance in the various localities, I am convinced that it is simply due to the extraordinary local fecundity of this species, and not to a migration of butterflies from Africa or the shores of the Mediterranean, as various French and Swiss journals have supposed. F. A. FOREL

Morges, Switzerland, June 23

Meteor

I SAW a bright meteor at Bath last night. It flashed into sight at a spot some 10° to the south of Arcturus at 10.38 P.M. The duration of its visibility was between two and three seconds, the direction of its path very nearly north-east to south-west, its brilliancy quite that of one of the so-called "fire-balls" in pyrotechnic displays. It travelled through about 25° of arc, leaving a very faint trail, which however disappeared almost immediately. What struck me as particularly remarkable about the meteor was the decided bluish-green colour of its light.

June 19 C. ARMBRUSTER

JOSEPH WILSON LOWRY, F.R.G.S.,

DEATH has just erased another well-known name from the roll of workers on the Geological Survey of Great Britain, that of J. W. Lowry, the eminent engraver whose maps, sections, and plates of fossils form so interesting a part of the records of this important branch of the scientific public service.

Joseph Wilson Lowry was the only son of Wilson Lowry, F.R.S., and Rebecca Lowry, well known as a mineralogist some seventy years ago; he was born October 7, 1803. His father was the leading architectural and mechanical engraver of his time, and he trained up his son to follow his own pursuits. From his early youth his father's house was the resort of men of high intellectual culture, and his mother's pursuits leading her also to associate with the scientific men of the day, what wonder that young Lowry early imbibed his parent's tastes and became an ardent lover of all natural history studies and pursuits, an accomplished draughtsman, and a well-informed scientific man.

His first practical effort was directed to the construction of a model in plaster of the Isle of Wight, geologically coloured, and divided transversely so as to give a section (also geologically coloured) through the centre of the island.

His pursuit of natural science led him early in life to become acquainted with John Phillips, at that time keeper of the Yorkshire Philosophical Society's Museum in York, and later on, when Assistant-General Secretary of the British Association for the Advancement of Science, or when associated with De la Beche on the Geological Survey, or when Professor of Geology in Oxford, until his death, Prof. Phillips remained the sincerely attached friend of J. W. Lowry.

Lowry's first important work as an engraver was the execution of the plates for the "Encyclopædia Metropolitana." He also executed for Sir John Rennie a series of plates of London Bridge. For many years Mr. Lowry prepared all the engravings for Scott Russell illustrative of wave-lines and the contours of ships. Mr. Lowry designed and executed numerous maps and charts for the Society for Promoting Christian Knowledge, the illustrations for Weale's Scientific Series, the atlas of maps published by the *Dispatch* newspaper, the first really cheap and good atlas ever produced.

The plates illustrating Phillips's "Geology of Yorkshire," and many other scientific works, were engraved by Mr. Lowry. We are also indebted to him for the excellent series of Natural History Charts of British Fossils, stratigraphically arranged, British Tertiary Fossils, Recent and Fossil Crustacea, by Dr. H. Woodward and J. W. Salter, &c. (Stanford's).

Hundreds of plates of fossils, exquisitely engraved, and maps and sections, too numerous to recount, published for the Geological Survey of Great Britain, amply testify to Mr. Lowry's rare ability as a scientific engraver. Even the familiar card-maps of each town visited year after year by the British Association were invented and produced by Mr. Lowry's skill and ingenuity.

But the days of engraving seem drawing to a close, at least so far as *printing* from engraved plates is concerned; but the beautiful plates prepared by Mr. Lowry cannot well be surpassed by modern lithography, save in cheapness.

Much as Mr. Lowry's work was valued by scientific men, his amiability of disposition and his modesty won for him even higher esteem among his friends. Many who knew him personally will recall his readiness on all occasions, even at great personal sacrifices, to help those who needed his assistance. His freshness of heart and kindness to young people were marked features in his character. He died on June 15. H. W.

DAVID MOORE, PH.D.

THE death of the Director of the Royal Botanical Gardens at Glasnevin, near Dublin, on June 9 last, has caused a very wide-spread sorrow among the botanists and horticulturists of Europe. Although Dr. Moore had attained the age of seventy-two, yet his physical strength was but little abated, and his mental powers were as strong as they were mature. A peculiarly severe attack of acute cystitis of scarcely four days' duration deprived us of a truly excellent and amiable man.

A native of Dundee, his father, attracted by the fame of Dr. MacKay, the Director of the Botanical Gardens belonging to the University of Dublin, and well known as the author of the "Flora Hibernica," sent David Moore to Dublin to be MacKay's apprentice. The apprentice soon learnt all the master had to teach, and was not long in qualifying himself to form one of the government staff, to whom, under the superintendence of the late General Portlock, was intrusted the Ordnance Survey of Ireland. This was in 1834; the Survey began in the County of Londonderry. In 1837 the first volume of its *Memoirs* was published, to which Moore contributed an essay on the flora of the region surveyed. Shortly after this he was elected by the then Council of the Royal Dublin Society to the charge of their Botanical Gardens at Glasnevin. These gardens are situated within a couple of miles of Dublin, and present a pleasing alternation of flat and gently rising ground, which then slopes to the borders of the little trout stream called the Tolka. They are associated with the memories of Tickell and Swift, and one walk amid old yew trees is still pointed out as the one much frequented by the Dean when inclined to moody meditation. To enumerate the changes brought about in these Gardens during the forty years' work of Moore, would be to write his and their history. It might almost be said that he found them a mixture of pleasure-ground and herb-garden; he has left them with all their native loveliness shown off to its very best, and containing for their size one of the best stocked collections in Europe. As the stranger walked there he was told of the literary men who sought for rest and quietness amid their shade; to the list of these sacred memories will now be added the name of a scientific man, whose daily labour for just forty years has resulted in making them known throughout the world. Amidst the practical labours of Moore's life science was not forgotten. He ably assisted MacKay in compiling his list of Irish plants. But he also devoted a great deal of attention to compiling a history of the mosses, liverworts, and algæ of his adopted country, and as the result of his maturer labours in this direction, he published in 1872 an account of the mosses of Ireland, and four years later an account of the Irish Hepaticæ. He, conjointly with A. G. Moore, F.L.S., published an account of the geographical distribution of plants in Ireland, under the title of "Cybele Hibernica." This is scarcely the place to record the numerous plants introduced by him to our gardens and stores, or to refer to the many interesting new hybrid forms brought into existence through his skill. For such scientific labours he was rewarded by being given the Ph.D. of Leipzig University, and with what we know he regarded as nearly as great an honour, in having the twenty-ninth volume of the third series of the *Kew Journal of Botany* dedicated to him by Sir Joseph Hooker, as "to one who, maintaining a very rich and beautiful botanic garden at a high standard of excellence, has advanced botanical science by many original observations and experiments."

Long will the memory of David Moore dwell in the minds of his many friends as that of one true and faithful, genial and generous.

THE RECENT ERUPTION OF ETNA

PROF. SILVESTRI has, with most commendable despatch, just issued his report to the Italian Government on the recent eruption of Etna. It takes the form of a quarto pamphlet of nineteen pages, entitled *Sulla doppia eruzione dell' Etna scoppiata il 26 Maggio*, 1879, and it is accompanied by a capital map, showing the exact extent and dimensions of the lava-streams. A reference to the map accompanying the previous article (p. 158) may help the reader to understand more clearly what follows.

At the end of our former article on the subject, we mentioned certain anomalies in the accounts of the eruption already transmitted by telegram from Rome, and at the same time asserted that we must wait for the Government Report before they could be explained. It is satisfactory to find that Prof. Silvestri has completely removed these anomalies, and has given a description of the eruption, which is so connected, reasonable, and precise, that it leaves nothing to be desired.

Silvestri considers that preparations for this eruption have been continued since 1874, and that this is the fulfilment of the abortive attempt which was then made. On August 29, 1874, a rift opened on the north-east side of the mountain, between the great crater and Mojo, and thirty-five small eruptive mouths were formed along its course, together with one larger crateriform monticule, which discharged lava. But after seven hours of activity, the dynamic forces suddenly decreased in intensity, and in two days' time nothing remained of the eruption save a few secondary manifestations. For a fortnight afterwards, however, earthquakes occurred on the north side of the mountain, and the great rift remained open. Silvestri predicted that when the next eruption came, this rift would prove the point of least resistance, and that the new lava would flow from it, or from craters raised along its course. This prediction has been completely verified.

The fissure of 1874 has extended itself—on the north-north-east towards Mojo, on the south-south-west towards Adernò. It is 10 kilometres (6·2 miles) in length, and passes through the great crater of Etna. On May 26, the south-western extremity discharged lava in the direction of Adernò while simultaneously the north-eastern extremity discharged lava in the direction of Mojo, thus presenting the curious anomaly of twin eruptions on opposite sides of the mountain. The craters on the south side of the mountain were situated near the base of Monte Frumento 2,650 metres (8,743 feet) above the sea. There were eight eruptive mouths, from 4 to 15 metres in diameter; seven of these were open, while over the eighth was raised a monticule. The lava did not flow directly towards Adernò, 13 kilometres distant, but towards a series of monticules formed during a previous eruption, and known as *Monti Grotta degli Archi*. It accumulated against the

first of these mounds, and then divided into two branches, one of which commenced to flow towards Adernò, and the other towards Biancarilla, but the supply died out at the source, and the new streams solidified at a height of 2,000 metres, having flowed for a mile and a quarter as a stream 400 metres in breadth. This stream did but little damage; it did not penetrate into the cultivated region, and but in short distance into the woody region. It came into contact, however, with a bed of snow, part of which it converted into clouds of steam, while another portion was liquefied and rushed down the sides of the mountain in a foaming torrent, carrying with it a good deal of *débris*.

The outflow of lava ceased on the south side of the mountain, because the lava found a vent at a lower level on the north side. As the one decreased in activity the other increased. On May 28th Silvestri visited the scene of the northern eruption. A great column of smoke appeared about 20° east of north, while a shower of sand descended, producing the "sad leaden light" (*la luce triste plumbea*) observable during an eclipse. More than two pounds of this sand were collected in ten minutes in an inverted umbrella, and the north flanks of the mountain were soon covered with it. Silvestri ascended from Randazzo towards the new craters, and when at a height of about 2,000 metres and near Monte Nero he heard loud subterranean detonations, and perceived severe oscillations of the soil. Soon afterwards he came upon the great rift, together with several smaller ones, converging towards the principal crater. In the immediate neighbourhood of Monte Nero and Timpa Rossa three new craters were seen, from one of which dense clouds of white smoke issued, while the others emitted lava and showers of ashes and incandescent stones. Frequent flashes of lightning issued from the smoke. The stream of lava near its source emitted a very bright light which, when viewed by a direct vision spectroscope, gave the lines of hydrogen, calcium, sodium, and potassium. The lava flowed downwards at a rapid rate: the wood of Collebasso was destroyed, and by the evening of May 29 it had flowed 6¼ miles, destroying the bridge of Passo Pisciaro and crossing the postal road between Randazzo and Linguaglossa. On Sunday the 31st the stream was rapidly approaching Mojo; the inhabitants became frightened, and brought out the figure of their patron Saint Antony, which was carried in procession to the edge of the stream, while the people fell on their knees and besought the Deity to save them from the impending danger. After the evening of June 1 the force of the eruption began somewhat to abate, and by the 6th inst. it was practically at an end. The lava stream ran nearly 7 miles from its source, and ultimately stopped 500 yards from the river Alcantara, and about half a mile from the village of Mojo. At its termination it is 23 feet in breadth and nearly 32 feet in height. The lava stream entered the bed of the Pisciaro torrent with a velocity of from 4 to 5 metres a second, which was reduced to 2 metres a minute in the lower valley of less inclination. In 76 hours the lava had flowed more than six miles from its source.

Indications of a disturbed volcanic condition were manifest last October, when powerful shocks of earthquake were felt in the territory of Mineo, Palagonia, Vizzini, Scordia, Militello, and Caltagirone. Mineo was the centre of disturbance, and here the shocks continued at intervals during the month of October. Loud subterranean noises were also heard at intervals. Two months later an eruption of mud and gas took place near Paternò, on the southern flanks of Etna. The mud was hot, salt, and petroleum-bearing (*fango salato termale petroleifero*), and its ejectment continued for several months. Towards the end of December last the whole eastern sea-board was visited by a strong shock of earthquake; and soon afterwards a great increase of smoke from the central crater of Etna showed that the dynamic activity of the mountain was unusually near the surface.

Even now we cannot regard the eruption as at an end Ten days after the cessation of the flow of lava telegrams from Rome (dated June 17) announced that the neighbourhood of Santa Venere and Guardia had been visited by repeated shocks of earthquake. A telegram on the following day announced that "an earthquake of great violence" had occurred near Aci Reale, destroying five villages. There is evidently a great deal of volcanic energy still pent up not far from the surface, and we must fear that before long a further outburst will relieve the imprisoned Titanic forces. G. F. RODWELL

THE ELECTRIC DISCHARGE WITH THE CHLORIDE OF SILVER BATTERY[1]

II.

THE HISTORY OF A TUBE

No. 129, *Hydrogen*

WE now give an account of the very great variety of phenomena presented by the same tube charged with hydrogen, No. 129 (see Plate), under different conditions of exhaustion when used in connection with batteries of various potentials, and traversed by currents of different strengths.

This tube is 32 inches long and 1·6 inch in diameter, the terminals are a straight wire and a ring, about 1 inch in diameter, both of aluminium; it is furnished with a glass stop-cock at each end, as represented in Fig. 3. The glass stop-cocks are connected with the mercurial pumps (Alvergniat and Sprengel) and with the gas generator respectively, as shown in Fig. 5.

Tube 129, *5th Charge of Hydrogen.*—A glow at both terminals was first seen when the pressure was 17·2 mm., 22,632 **M**,[2] with 8,040 cells, and great heat developed in the dark discharge near the middle of the tube. The spectroscope showed faintly the C and F lines.

Pressure 16·5 mm., 21,710 **M**, 8,040 cells. One luminosity like that on the right hand of Fig. 10, sho out from the positive and approached to within 6 inches of the negative, then receded back and disappeared.

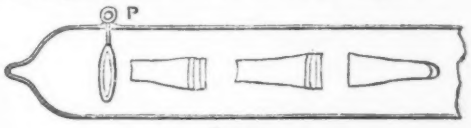

FIG. 10.

Pressure 15·8 mm., 20,789 **M**, 8,040 cells. 3 luminosities, very steady, which moved slowly and steadily towards the negative. The tube hottest in dark part where there was probably a non-luminous entity.

Pressure 14 mm., 18,421 **M**, with 6,840 cells, the current was unsteady, but it was perfectly steady with 8,040, and 6 arrow-headed luminosities like that on the left of Fig. 11, were produced and soon disappeared.

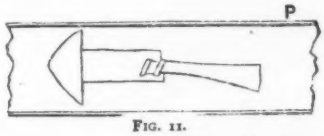

FIG. 11.

Pressure 10·3 mm., 13,552 **M**, with 8,040 cells. 8 luminosities something like 1, Fig. 12.

Pressure 9·4 mm., 12,368 **M**, with 8,040 cells. 12 luminosities like those, Fig. 7 in the Plate. The C and F lines seen in the glow around the negative.

Pressure 7·7 mm., 10,132 **M**, with 8,040 cells. 10 luminosities like Fig. 6 in the Plate; these ran together and disappeared and reappeared in a few seconds.

[1] Continued from p. 178.

[2] **M** = millionths of an atmosphere.

Pressure 6·6 mm., 8,684 **M**, with 8,040 cells. 12 luminosities very similar to those shown at Fig. 5 in the Plate, the last adhering to the positive. The C line not visible in a nebulosity with the spectroscope, but that and the F line were both to be seen in the glow around the negative.

Pressure 5·9 mm., 7,763 **M**, 8,040 cells, C. 0·02056 **W**.[1] 13 luminosities like those Fig. 6 in the Plate. With 100,000 ohms, C. 0·01390 **W**, there were 10 luminosities not so wide as those when there was no resistance.

Pressure 6·1 mm., 8,026 **M**, 8,040 cells, C. 0·01910 **W**. At first 13 luminosities a little unsteady, then 11½ perfectly steady, like Fig. 6 in the Plate. F and C visible in the glow around negative. F was not visible in a luminosity.

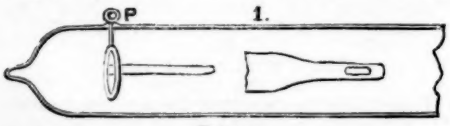

FIG. 12.

Pressure 4·4 mm., 5,789 **M**, 8,040 cells. 12 luminosities as depicted in Fig. 6 in the Plate, which is copied from a photograph[2] obtained in 4 seconds.

Pressure 4·0 mm., 5,263 **M**, 8,040 cells. 15 luminosities as shown in Fig. 7 in the Plate, from a photograph taken in 4 seconds.

Pressure 3·6 mm., 4,737 **M**, 8,040 cells, 30,000 ohms resistance. 15 luminosities almost touching, like Fig. 7 in the Plate.

Pressure 3 mm., 3,947 **M**, 4,800 cells, C. 0·0362 **W**, the resistance of the tube being 88,600 ohms. There were 24 steady blue strata and a space of about 6 inches confused towards the positive; with 200,000 ohms resistance in the circuit the strata became pink, the current being 0·01469 **W**.

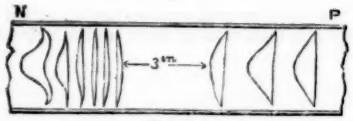

FIG. 13.

Pressure 1 mm., 1,316 **M**, 3,600 cells, C. 0·03896 **W**, the resistance of the tube being 59,170 ohms. The tube was filled to within one inch of the negative with strata all blue, but they turned pink and tongue-shaped when 200,000 ohms resistance was introduced, which reduced the observed current to 0·00782 **W**. The C and F lines visible in the luminosities. When 7,590,000 ohms resistance was introduced, a very close and somewhat agitated pink stratification was produced, like the left of Fig. 13.

Some gas let in, pressure 3 mm., 3,947 **M**, 3,600 cells gave a current of 0·04901 **W**; the resistance of the tube was ascertained by substituting 47,000 ohms wire resistance, which produced the same deflection. The strata were blue, like those of 55 and 56, Fig. 14. For about 10 inches from the negative they took up an axial backwards and forwards steady rotation of about a quarter turn.

With 174,000 ohms resistance, making with the battery and tube a total of 261,000, the current measured was 0·00879 **W**. The strata turned pink and assumed the tongue-form, Fig. 15; with 783,000 ohms in circuit very close strata. In the rotating mirror a flow *towards the positive* was observed until a break occurred in the stratification; the flow was then irregular and backwards and forwards.

Pressure 1·7 mm., 2,237 **M**. The current of 2,400 cells passed; with 3,600 cells the current was 0·03858 **W**, producing perfectly steady strata, of which a photograph was obtained in four seconds; a facsimile of it is given, Fig. 8 in the Plate. The strata were blue, but on introducing 500,000 resistance the current was reduced to 0·00175 **W**, and the strata turned pink and assumed the form Fig. 9 in the Plate, which is a facsimile of a photograph obtained in 19 seconds.

Pressure 0·8 mm., 1,052 **M**, 3,600 cells (C.) 0·19940 **W**. A spiral series of tongues depicted in Fig. 10 in the Plate, from a photograph which, however, could scarcely be exposed long enough in consequence of the screw-like motion of the tongues. This motion appeared to be from positive to negative.[1] On introducing 900,000 ohms resistance, (C.) 0·003414 **W**, the tongues grouped themselves in pairs, of which there were 40, and changed from blue to pink. Examined with the spectroscope, the line C had disappeared. The tube was connected with the condenser of 42·8 microfarads and 3,240 cells, a resistance of 200,000 ohms being in circuit (C.) 0·007461 **W**. At the full potential the same spiral series of blue tongues, quite steady, was produced, and these made a complete rotation in 30 seconds. On breaking connection between the battery and condenser, the strata gradually changed to pink as the charge of the condenser ran down through the tube.

Tube 129, *6th Charge of Hydrogen.*—The tube, at 0·9 mm., 1,184 **M**, was partially charged with hydrogen by letting in 4 small calibrated charges, which increased the pressure each time 1·4 mm., pressure 6·5 mm., 8,684 **M**, the resistance of the tube was found to be 170,000 ohms, and the total resistance of the whole, 8,040 cells, 130,000 ohms, or an average of 16·6 per cell. With 6,960 cells the current, through the tube alone, was 0·02456 **W**, and there were produced 9 luminous entities as shown in Fig. 5 in the Plate, taken from a photograph obtained in 1½ second.

The gas in the tube at the same pressure, namely,

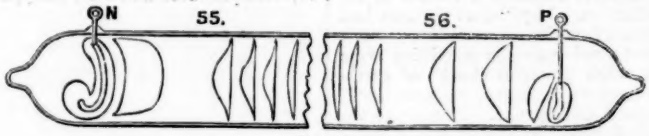

FIG. 14.

6·5 mm., 8,040 cells, C. 0·02634 **W**. There were 7 entities as depicted in Fig. 4 in the Plate, copied from a photograph obtained in one second.

Pressure 6·5 mm., on the introduction of 300,000 ohms resistance with 8,040 cells, C. 0·0138 **W**, making a total resistance, inclusive of the tube and the battery, of 600,000 ohms, two luminosities were produced as seen in Fig. 2 in the Plate, taken from a photograph obtained in 2 seconds, which, however, had to be corrected from a drawing, as there was a slight movement in the luminosities.

Pressure 3·6 mm., 4,737 **M**, 4,800 cells. Strata resembling Fig. 16, but near the negative the strata were

[1] C denotes currents; **W** webers.

[2] Varley, C. F. (*Proc.* Roy. Soc., xix., 1871, pp. 238–239) succeeded in photographing by an exposure of thirty minutes an *arch discharge* in a vacuum tube, so faint that in a perfectly dark room he was "sometimes unaware whether the current was passing or not."

[1] De la Rive (Genève *Mém.* Soc. Phys. xvii., 1863, p. 72) describing the appearance of a nitrogen tube, says: "Ces stries semblent former une hélice animée d'un mouvement de rotation autour de son axe."

indistinct. In the rotating mirror the distinct strata were steady, but in the indistinct portion there was indicated a rapid flow *towards the positive*. The lines C, F, and G seen in the glow around negative terminal, but C and G were not seen in the strata.

Pressure 1·2 mm., 1,579 **M**, 2,400 cells, C. 0·03251 **W**. 11 narrow strata, umbrella-shaped, about ¾ of inch wide, followed by two about 1¼ inch wide, then a confused discharge, in which the rotating mirror showed a rapid flow *towards the positive*. C, F, and G lines visible in

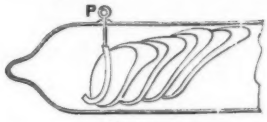

Fig. 15.

the negative glow; G and C disappeared in the strata, and F was very faint.

Tube 139, *Hydrogen*.—Pressure 6·319 mm., 8,314 **M**, 8,040 cells. Three arrow-headed luminosities as depicted in Fig. 3 in the Plate, copied from a photograph and a drawing made at the time. The photograph was obtained in 2 seconds.

Pressure 9·502 mm., 12,526 **M**, 6,960 cells. One luminosity of which a photograph was obtained in 10 seconds but has not been copied. Another photograph obtained

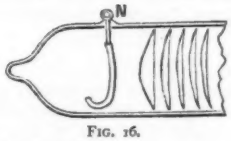

Fig. 16.

in 1 minute is shown in Fig. 1 in the Plate, it will be observed that it has a spear-head continuation towards the negative.

Pressure 0·051 mm., 67 **M**, the current of 3,600 cells passed intermittently; 4,806 cells, C. 0·00191 **W**, produced a continuous illumination from the positive to within 3 inches of the negative, the discharge at the negative licking the inside of the tube.

Pressure 0·01 mm., 13 **M**, the current of 4,800 rod cells just passed: with 6,960 cells the current produced no appreciable deflection of our galvanometer which would indicate 0·00024 **W**. The strata thickened and became much wider. The discharge at the negative licked the side of the tube and was very sensitive to the approach of the finger.

By standing 16 hours the pressure had somewhat increased without leakage having occurred, and was 0·037 mm., 49 **M**, 6,960 cells, current less than 0·00024 **W**; the discharge was milky white and quite different from anything before seen by us with a hydrogen residual charge. The strata had become still broader, the negative discharge hugging the tube and being very sensitive to the finger. The C and F lines could not be seen with the spectroscope, but there was a double green line near *b*.

A charge of hydrogen was let in, the charge being 0·001725 of the capacity of the tube and pump, and increased the pressure to 1·311 mm., 1,725 **M**. 3,600 rod cells produced a stratification composed of umbrella-shaped strata, united in the middle of the tube by a luminosity one-third the length of the tube. The double green line near *b* had disappeared, and the C, F, and G lines were visible in the spectroscope.

Another calibrated charge of hydrogen was let in and raised the pressure to 2·622 mm., 3,550 **M**; the current of 3,600 cells just passed: with 4,800 cells a phase was produced resembling tube 129, Fig. 7 in the Plate.

Another most interesting tube was a favourite of our friend the late Mr. Gassiot, and was presented by him, with many others, to Mr. Spottiswoode. It retains, in a remarkable degree, the record of old stratification by bands of dark deposit with clear spaces between them. It was a matter of interest to ascertain whether the lines of deposit coincided with the position of the spaces or with that of the strata. This tube is composed of a cylinder 13 inches long, and 1 3/16 inch in diameter, having at one end a bulb 2 inches in diameter, from which project at right angles to the main tube two short lengths of tube 1⅜ inch in diameter, the whole resembling in form the letter T. At the end of the tube opposite the bulb is a straight brass wire ⅛ inch in diameter screwed on to a wire of platinum, and in the head of the T a brass wire, 4¾ inches long, reaching axially right across. The bulb and short tubes attached to it are completely coated with a dense black metallic deposit, and for a space of 5 inches from the bulb, the main tube is stained with eight dark bands. 2,400 cells gave a current 0·02289 **W**, the straight wire being positive, and the cross wire in the bulb

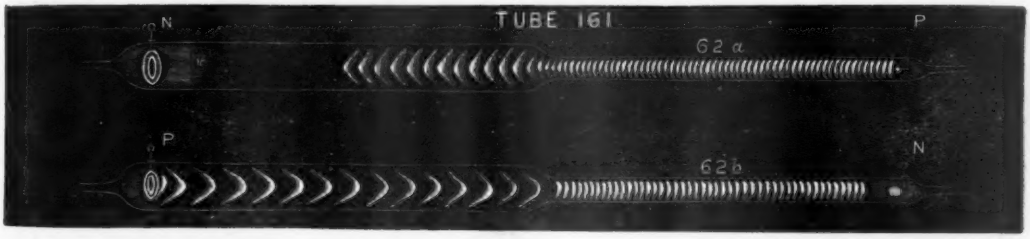

Fig. 17.

negative; there were produced beautiful double strata intensely blue, completely filling the tube. Strips of paper were fastened over these strata in the region of the stains; these were found to occupy the *unstained spaces;* the stains therefore marked the *intervals*, or cooler parts, between former strata.

Tube 161, *Hydrogen*.—The difference of the strata in tubes of different diameter at the same pressure and with the same current is very clearly brought out in tube 161, composed of two portions, one being 18 inches long and 1·65 inch internal diameter, the other 17·5 inches long, and 0·975 inch diameter, the ratio of the sectional areas being 2·864 to 1. The terminal in the small tube is a point, in the large one a ring.

With 4,800 cells, the point (small tube) positive C. 0·02825 **W**, there were produced in the small tube 62 disk-shaped strata, and in the large tube twelve cup-shaped strata occupying half of the length of the large tube; beyond these the discharge was dark. With the point negative, C. 0·02451, there were produced in the small tube 54 disks, and in the large tube thirteen cup-shaped, completely filling it. The number of strata does not, therefore, appear to be in the inverse ratio of the areas. The strata in the small tube were blue, but

at times, with a large current, carmine, as in the capillary part of a spectrum-analysis hydrogen-tube, the strata in the large tube being much fainter and pink. The appearance when the point was positive is shown in the diagram, Fig. 17, 62*a*, and when negative in 62*b*, copied from photographs obtained, the former in 15 seconds, the latter in 10 seconds. Another example is shown in Fig. 12 in the Plate.

Tube 160, *Hydrogen*.—This tube was constructed with the object of sending the analogue of a smoke ring through a tube in which a steady stratification had been procured and sustained; Fig. 18 shows the arrangement.

The tube is 40 inches long and 1·875 inch in diameter, and has a stop cock at each end; near one of the ends is a small tube, 0·75 inch in diameter, sealed to the main

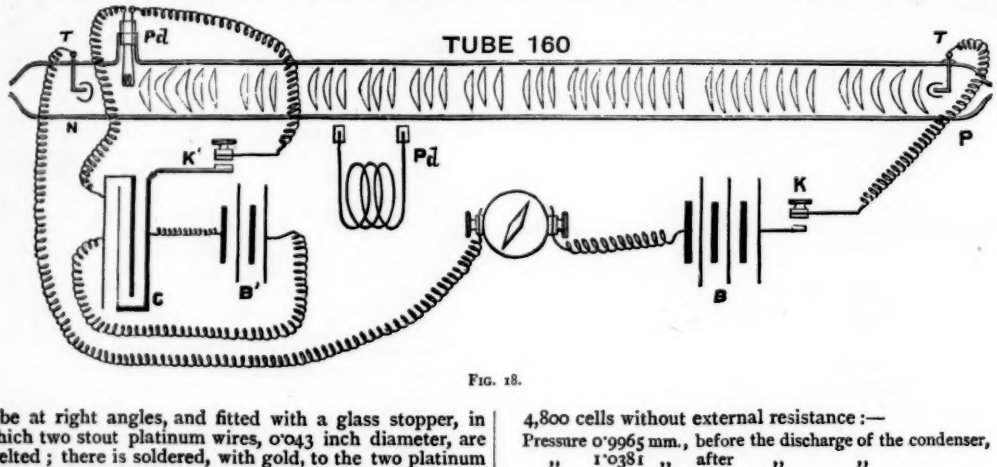

FIG. 18.

tube at right angles, and fitted with a glass stopper, in which two stout platinum wires, 0·043 inch diameter, are melted; there is soldered, with gold, to the two platinum wires a spiral of palladium made of wire 12 inches long and 0·0125 inch diameter, P*d*, in the diagram. The palladium coil was charged to saturation with hydrogen, by immersing it in dilute sulphuric acid and making it the negative pole of a bichromate battery of six elements; after it had been washed in distilled water it was dried and inserted in the tube. The two stout wires of platinum, to which the palladium coil is attached, are connected to a condenser of 10·9 m.f., charged with 3,240 cells. One of the wires leads to the key K', so that no current can pass from the condenser until this key is pressed down; when this is done the charge passes, and by suddenly gniting the wire drives off the hydrogen.

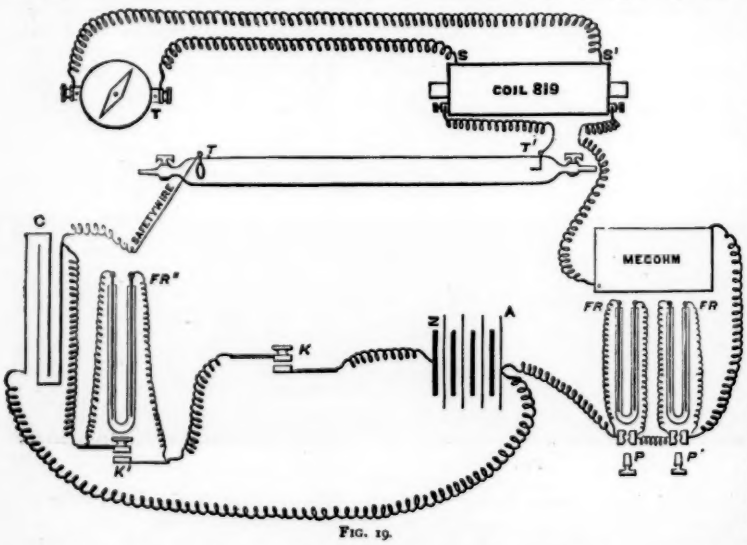

FIG. 19.

4,800 cells without external resistance:—

Pressure 0·9965 mm., before the discharge of the condenser,
" 1·0381 " after " "

Difference 0·0416 " 55 M,

strata were produced from the positive up to the palladium coil which was on the negative side. On liberating hydrogen by the discharge of the condenser these were driven back 14 inches towards the positive, and subsequently only a confused discharge was produced.

When the terminal near the coil was positive the same phenomena were not produced on the discharge of the condenser.

In order to test whether it would be possible to render evident pulsations in the current when perfectly steady strata are produced in tubes containing residual gases, we arranged the detector apparatus as shown in Fig. 19.

A Z is the battery; A being connected through the fluid resistances F R, F R' (which can be plugged out of circuit by means of P and P'), the megohm wire resistance, and the primary of Apps' induction-coil No. 819, to the terminal T' of the tube; the terminal A is also connected direct to one plate of the condenser C. Z is connected through the key K to the fluid resistance F R" (which can be plugged out by pressing down the key K'), thence to the other plate of the condenser, and through the safety-wire to the other terminal T of the tube. The secondary wire of coil 819 is connected to a delicate Thomson galvanometer T.

Many observations were made with coil No. 819, which we had taken to pieces several times during the course of our trials, on account of suspected leakage from the

primary to the secondary wire. It was ultimately entirely remade in February, 1878, and the secondary wire coiled on a separate ebonite cylinder to insure efficient insulation, which was accomplished.

In every case where the strata are to the eye or rotating mirror perfectly steady, slight deflections of the needle are seen; these generally indicate a resultant *direct* current (break-contact), and in the fewer number of cases an *inverse* current indicating, in the first case, a *sudden* decrease and *slow* increase of current through the tube. These deflections, though very manifest, do not amount to more than about three or four divisions of the galvanometer scale, a deflection which indicates a current of only 0·000000000023 **W**. At the advent or retreat of a stratum at the positive pole there is frequently produced a deviation of 300 divisions, indicating a current of 0·000000001812 **W**; before a stratum leaves the positive terminal or dies out on it, there is usually a tremulous motion of that stratum visible to the eye and indicated by rapid pulsations of the galvanometer.

On the suggestion of Prof. Clerk Maxwell we have recently introduced the telephone into the primary current, as shown in Fig. 20, and also in the secondary current of coil 819.

In all cases where the condenser C was discharging itself gradually through the tube, a low rustling sound was distinctly audible to sensitive ears so long as the stratification remained *apparently* perfectly steady. When the phase of confused stratification which immediately precedes extinction was reached, the sound in the telephone became very loud and rose in pitch, with some tubes becoming quite shrill. These results, therefore, confirm the conclusion already arrived at from other experiments, namely, that the discharge in vacuum tubes is intermittent; but we do not pretend that they make it manifest that stratification is *dependent* upon intermittence.

In the course of our experiments, using sometimes 11,000 cells, we have arrived at the following facts:—

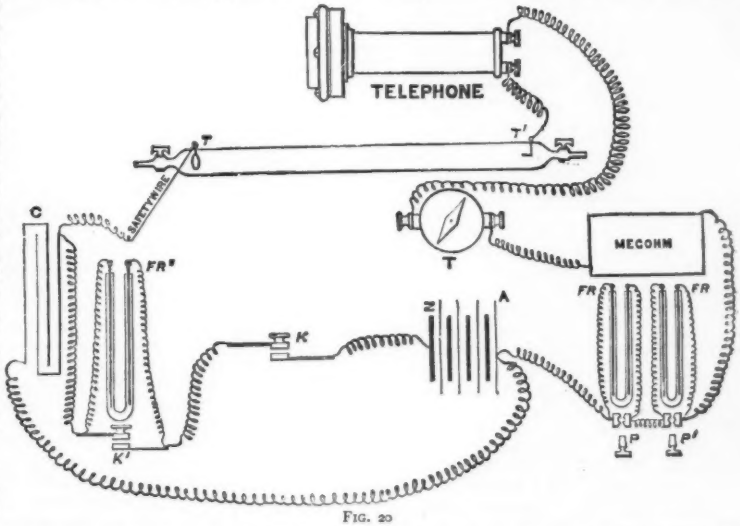

FIG. 20

1. *The discharge in a vacuum tube does not differ essentially from that in air and other gases at ordinary atmospheric pressures; it cannot be considered as a current in the ordinary acceptation of the term, but must be of the nature of a disruptive discharge, the molecules of the gas acting as carriers of electrification. The gases in all probability receive impulses in two directions at right angles to each other, that from the negative being the more continuous of the two. Metal is frequently carried from the terminals and is deposited on the inside of the tube, so as to leave a permanent record of the spaces between the strata.*

2. *As the exhaustion proceeds, the potential necessary to cause a current to pass diminishes up to a certain point, whence it again increases, and the strata thicken and diminish in number, until a point is reached at which, notwithstanding the high electromotive force available, no discharge through the residual gas can be detected.* Thus, when one pole of a battery of 8,040 cells was led to one of the terminals of tube 143, Fig. 21, which has a radiometer attached to it, the other terminal of the tube, distant only 0·1 inch, being connected through a sensitive Thomson galvanometer to the other pole of the battery (earth), the current observed was not greater than that which was found to be due to conduction over and through the glass. Although no current passed, the leading wires acting inductively stopped the motion of the radiometer, as has been observed by Sir William Grove.

3. *All strata have their origin at the positive pole.* Thus, in a given tube, with a certain gas, there is produced at a certain pressure, in the first instance, only one luminosity which forms on the positive terminal, then, as the exhaustion is gradually carried further, it detaches itself, moving towards the negative, and being followed by other luminosities, which gradually increase in number up to a certain point.

4. *With the same potential the phenomena vary irregularly with the amount of current.* Sometimes, as the current is increased, the number of strata in certain tubes increases, and as it is diminished their number decreases; but with other tubes the number of strata frequently increases with a diminution of current. If the source of the current is a charged condenser, the flow being from one of its plates through resistances and the tube to the other; then, as the potential of the condenser falls and the current diminishes, the number of strata alters; if the strata diminish in number with the fall of potential, then the stratum nearest the positive wire disappears on it, the next then follows and disappears, and so on with others; if, on the other hand, the charge of the condenser is very gradually increased, the strata pour in, one after the other, in the most steady and beautiful manner from the positive.

FIG. 21.

5. *A change of current frequently produces an entire change in the colour of the strata:* for example, in a hydrogen tube from a cobalt blue to a pink. It also changes the spectrum of the strata; moreover, the spectra of the illuminated terminals and the strata differ.

6. *If the discharge is irregular and the strata indistinct, an alteration of the amount of current makes the strata distinct and steady.* Most frequently a point of steadiness is produced by the careful introduction of external resistance; subsequently the introduction of more resistance produces a new phase of unsteadiness, and still more resistance another phase of steady and distinct stratification.

7. *The greatest heat is in the vicinity of the strata.* This can be best observed when the tube contains either only one stratum, or a small number separated by a broad interval. There is reason to believe that even in the dark discharge there may be strata, for we have found a development of heat in the middle of a tube in which there was no illumination except on the terminals.

8. *Even when the strata are to all appearance perfectly steady, a pulsation can be detected in the current; but it is not proved that the strata depend upon intermittence.*

9. *There is no current from a battery through a tube divided by a glass division into two chambers, and the tube can only be illuminated by alternating charges.*

10. *In the same tube and with the same gas, a very great variety of phenomena can be produced by varying the pressure and the current. The luminosities and strata, in their various forms, can be reproduced in the same tube, or in others having similar dimensions.*

11. *At the same pressure and with the same current, the diameter of the tube affects the character of the discharge and the form and closeness of the stratification.*

THE ROYAL SOCIETY OF EDINBURGH

THE goodly volume of the proceedings of this Society for the session 1877-78 witnesses to the zeal and success with which scientific problems, whether of general or of more specially local interest, are attacked by our northern *savants*.

The fascination in which the public mind has been held by those remarkable instruments, the telephone, phonograph, and microphone, here matures in fruitful study of them. Prominent among the researches referred to are those of Prof. Fleeming Jenkin and Mr. Ewing on the wave-forms of articulate sounds, as obtained from the phonograph (already described in our columns), and the thoughtful investigations of Dr. Ferguson on the indications of molecular action in the telephone, leading to the conclusion that at the sending-station the evidence of molecular action, though suggestive, is by no means conclusive, whereas at the receiving-station, the existence of molecular as well as mechanical action amounts to demonstration, and it is shown to be considerable in amount. Several striking observations in the same field are recorded by Professors McKendrick, Tait, and Forbes, Mr. Blyth, and others. In a paper on beats of imperfect harmonies, Sir William Thomson develops the theory of the phenomenon, and affirms (as a result of experiment) that in every case the ear distinguishes the two halves of the period of each beat, represented respectively by a sharp-topped and flat-hollowed curve and by a flat-topped and sharp-hollowed curve.

The Fourth Report of the Boulder Committee communicates many instructive facts, especially as regards transport of boulders. In his appended remarks Dr. Home shows reason for thinking that two notable spherical balls of marcasite found in the boulder clay at Leith, came from the westward, one from Campsie or Kilsyth (not less than thirty miles), the other from Humbie, nine or ten miles due west of Edinburgh. A geological study of the district indicates the agency of deep-sea currents loaded with ice, which flowed upon the Campsie Hills from the west-north-west, scooping out the present valley and breaking up, to a large extent, the coal strata in it. Thus some of the nodules in these strata would find their way to Leith, where they were embedded Several cases are noted in which boulders, to reach their present sites, must have crossed arms of the sea (*e.g.*, boulders in Staffa, at Appin, and in Loch Creran, from Mull, and others in Nairn, from Ross-shire). The high position of many boulders is explained by Prof. Judd's supposition, that in pliocene times there were mountains in Skye, Mull, Ardnamurchan, and even in Rum, some of which reached a height of at least 14,000 feet. In another geological paper Prof. Geikie traces out the limits of the different basins in which the old red sandstone of the British Islands was deposited, distinguishing the basins as Lakes Orcadie, Caledonia, Cheviot, Lorne, and the Welsh Lake. Dealing with the first alone, he examines the evidence for Murchison's three-fold arrangement of the old red sandstone (finding the middle division only in the north of Scotland), and describes the various districts of Lake Orcadie *seriatim*.

From experiments on suspension, solution, and chemical combination, Mr. William Durham concludes that these phenomena differ only in degree, and are manifestations of the same force. The attraction of chemical affinity is not, in all cases at least, exhausted when a definite compound is formed, but has sufficient power left to form solution or suspension compounds. The same force operating in chemical combination and solution, explains the powerful effects of solution in promoting chemical reaction and electric conductivity. Among chemical subjects treated, are the action of heat on some salts of trimethyl sulphine (Brown and Blackie), the action of chlorides of iodine on acetylene and ethylene (McGowan), and the crystallisation of isomorphous salts (Robinson).

In physiology, we note an extension of Prof. Rutherford and Messrs. Vignals' experiments on the biliary secretion, with reference to the action of cholagogues. The effects of fifty-two medicinal agents on the liver (of dogs) have been investigated, and the great majority of the conclusions are in complete harmony with the results of clinical observation, while many new facts are given to the physician.—Mr. Newman successfully imitates in a physical experiment, the function of the kidney.—Mr. Stirling furnishes some notes of the fungus disease affecting salmon.

A sketch is given by Mr. Edward Lang, of the arrangement of tables of ballistic curves in a medium resisting as the square of the velocity, and of the application of these tables to gunnery.

Without further enumeration, we may direct attention to some interesting accounts of that rare phenomenon, a white sunbow, witnessed at Edinburgh on January 10 last year.

OUR ASTRONOMICAL COLUMN

THE SATURNIAN SATELLITE HYPERION.—Prof. Asaph Hall has investigated the elements of this satellite, first from thirty of the best observations made at Washington in 1875, and again from thirty observations by Mr. Lassell at Malta, in 1852-53. In the former case the approximate elements in *Astron. Nach.* No. 2137 were used in the calculation of equations of condition, which were solved by the method of least squares. The resulting orbit is as follows :—

Passage through perisaturnium, 1875, Oct. 27·8380 Greenwich M.T.

Perisaturnium	172 59·7	For 1875,82.
Ascending Node ...	120 12·0	Referred to the plane
Inclination	6 12·1	of the earth's equator.
Excentricity	0·11885	
Semi-axis major	216″·56	

Assuming these values for the node and inclination, Mr. Lassell's observations were discussed and gave the elements :—

Passage through perisaturnium, 1852, Nov. 17·5208 G.M.T.

Perisaturnium	... ...	240° 10′·9
Excentricity	... ...	0·12011
Semi-axis major	...	217″·05

It will be seen that the position of the perisaturnium had undergone a great change in the interval between the above epochs : the rapid motion of the line of apsides has been known for some time past to those who have attempted the determination of elements of Hyperion. Prof. Hall had at first supposed this motion direct, but he now adopts the smaller retrograde motion, and so finds for the motion of the line of apsides in a Julian year,—2°·92862. If we assume that 394 revolutions of the satellite had been performed in the interval between the epochs (8379·3172 days), the anomalistic period is found to be 21·2673026 days.

Prof. Hall thinks that the next step must be the calculation of the action of the great satellite Titan on the motion of Hyperion, a work which he hopes to be able to undertake. Not only is there a near approach of the orbits of the two bodies, but it would appear that Hyperion is moving in a larger orbit, than would correspond to the assigned period and Bessel's mass of Saturn. There is a probability that the approximation of the two satellites may be, at certain times, very close indeed. If we bring up Bessel's elements of Titan to 1875, and compare them with the above elements of Hyperion for the same year, we find an exceedingly near approach of the two bodies, when the position of the perisaturnium of Hyperion corresponds to that of maximum distance of Titan, and though uncertainty in the elements may affect the result, it is sufficiently evident that the motion of Hyperion cannot be followed satisfactorily without a knowledge of the action of Titan. Prof. Hall remarks that in 1882 it may be possible with the Washington refractor to follow Hyperion completely round its primary, as was done by Mr. Lassell at Valetta in 1852, and that from that time until 1888 it should be carefully observed.

THE OXFORD UNIVERSITY OBSERVATORY.—The report of the Savilian Professor of Astronomy, as Director of the University Observatory at Oxford, has been issued, for the year ending on the 4th of the present month. The 12¼ inch refractor has been in constant use in the determination of accurate positions of about 40 stars in the Pleiades, partly with the view of ascertaining the proper motions by comparison with the observations of Bessel half a century ago, and partly with the intention of comparing the micrometrical measures with those of the costly heliometer. The results will appear in Part II. of the Oxford Observations, and we may remark that the Savilian Professor will have a recent standard for comparison in M. Wolf's elaborate work on the Pleiades, (*Description du Groupe des Pleiades* in the Paris *Annales*, t. xiv.), to which he has not made allusion in the report. The De la Rue reflector has been employed in taking photographs of the moon, and nearly three hundred have been secured. With the view of ascertaining how far these photographs can be relied upon for accurate measurements, micrometrical measures of the shadows of several prominent lunar mountains were made with the refractor, simultaneously with the taking of photographs with the reflector; the latter being then measured in the De la Rue engine, it was found that the telescopic and photographic results were in close accordance, indeed within the limits of the unavoidable errors of observation. The Professor adduces a still further proof of the reliability of celestial photography in this direction, in the close accordance of the moon's semi-diameter, as measured and computed from sixteen of the Oxford photographs with Hansen's value adopted in the *Nautical Almanac*; the difference is only 0″·12. Amongst the other miscellaneous work of the Observatory during the past year, the periodical comets of Tempel (1873 July) and Brorsen have been well observed. In the Lecture Room discourses have been delivered on the Astronomy and Astronomical Instruments of Ptolemy and Hipparchus, on the Physical Libration of the Moon and on Solar Physics.

The obligation under which this institution remains to the great liberality and scientific spirit of Dr. De la Rue is well known. The salary of the photographic assistant has been defrayed by him during a period of four years, this subsidy, a most important one to the rising Observatory, terminating in December next. The necessary provision for the future effective conduct of the Observatory is under the consideration of the University Commissioners, subject to the final judgment of Convocation. It is suggested by the Savilian Professor in his report, that for the next few years a sum of 600*l.* annually may suffice to cover all necessary expenses. The desirability of an early publication of results, in the actual state of Astronomical Science, appears to be fully appreciated in the Oxford establishment : part I. of the Observations containing the work to December 1877 was published in the spring of 1878.

A NEW COMET.—A pretty bright telescopic comet was detected, apparently on the 16th inst., by Mr. Lewis Swift, of Rochester, N.Y. Prof. Winnecke observed it at Strasburg on June 21, and found its position at 11h. 38m. 46s. mean time in R.A. 2h. 47m. 31·1s., Decl. 64° 29′ 5″; daily motion in R.A. trifling, that in Decl. about one degree towards the north ; diameter about three minutes.

GEOGRAPHICAL NOTES

AT the meeting of the Royal Geographical Society on Monday evening, after a feeling allusion by the Earl of Northbrook to the loss sustained by the Society by the death of Mr. R. B. Shaw, British Resident at Mandalay, who was well-known for his excellent geographical work in Eastern Turkistan, &c., some reports were read which had recently been received from Mr. Keith Johnston, the leader of the East African Expedition. The first was an exceedingly interesting account of his preliminary trip from Zanzibar to the Usambara Hills, and the second was a memorandum of information obtained regarding routes between Dar-es-Salaam and the north end of Lake Nyassa. It is no exaggeration to say that the latter document contained more real geography than many travellers contrive to collect in the course of a long journey, and it confirms the impression that Mr. Johnston, if he be spared, will, on his return from the interior, furnish us with a most admirable and accurate account of the country traversed, the greater part of which is at present absolutely unexplored. The Secretary afterwards read letters from Mr. Johnston and Dr. Kirk, H.M.'s Consul-General at Zanzibar, announcing the final start of the expedition for the interior, under the most favourable circumstances. Mr. Johnston has with him one European assistant and 138 porters, who have been carefully selected with the aid of Chuma, Livingstone's old follower, who also accompanies the party.

THE last sitting of the Geographical Society of Paris, was devoted to a lecture given by M. Cosson to prove (1) that M. Roudaire's contemplated Algerian sea would not improve the climate of the Sahara; (2) that in case any alteration were possible it would be detrimental to the health of the inhabitants; (3) that it would create dissatisfaction amongst the Tunisian and Algerian tribes, and even Algerian colonists; and (4) that it would have no effect in attracting to Algiers the trade of the Soudan. Commander Roudaire not having been invited to answer the charges proffered against his scheme the discussion was adjourned, but several members warmly protested against the assumption brought forward by M. Cosson, and tried to rebut his assertions.

CAPTAIN R. H. NAPIER, R.N., has communicated some useful hydrographic notes to the Hong Kong

Government Gazette respecting the Chinese island of Hainan and the Gulf of Tongking. The following are the positions determined:—Hoihow Fort A, lat. 20° 3′ 13″ N. long. 110° 19′ 3″ E.; Pakhoi Customs flagstaff lat. 21° 29′ N. long. 109° 6′ 6″ E.; Guie-chow Island summit lat. 20° 1′ 15″ N., long. 109° 6′ 31″; Cape Cami lat. 20° 11′ 58″ N., long. 109° 54′ 57″ E.; North Taya Island, lat. 19° 58′, N., long. 111° 16′ E.

IT is stated that Major Serpa Pinto will come to London soon to give a lecture on his recent journey across Africa.

SIR SAMUEL BAKER, who has spent the last six months in traversing the island of Cyprus in a gipsy waggon, carefully observing all the natural phenomena, is engaged in writing a book to be called "Cyprus as I saw it in 1879," which will be published by Messrs. Macmillan and Co.

THE newly published *Bulletin* of the Belgian Geographical Society contains two papers by their indefatigable vice-president, Colonel Adan, one of which is entitled "Sur la Participation des Officiers aux grands Travaux de Géographie Scientifique." M. Greiner contributes some notes on the cultivation of tobacco. We are glad to observe that considerable space (upwards of 29 pp.) is devoted to "Chronique Géographique," and much care is evidently bestowed on the collection of matter. Among these notes there is one of much interest on the proposal for connecting Liége and Escaut by means of a canal.

THE ever-interesting *Monatschrift für den Orient* for June contains several papers of varied interest. Georg v. Gyurkovics writes on the trade politics of Bulgaria; Dr. G. Schweinfurth sends from Cairo some notes on Rohlf's last exploring journey in Tunisian territory. In view of the new relations of Germany with the Samoan Islands, Dr. Hubbe-Schleiden's article on Germany in the Pacific is well timed, and so from another point of view is Herr Josef Hras's letter from Shanghai on the Kulja Question. Under the title of Tsin and Ta-Tsin Count Schweiger-Lerchenfeld contributes a learned paper on the old trade routes of the Chinese.

THE principal paper in the June number of Petermann's *Mittheilungen* is a long account by M. A. Woeikoff of his travels in Yucatan and the south-east provinces of Mexico in 1874. As might be expected from so accomplished and experienced a traveller, the paper is very comprehensive and full of original observations on the many interesting features of the region visited. Dr. P. Jonas, contributes the conclusion of a paper begun some time since on Venezuela, describing a journey he made through the Llanos to the Apure. Dr. Emin Bey continues his valuable narrative of his journey from Mruli to the chief town of Unyoro, and Herr B. Hassenstein describes the north coast of Siberia between the mouth of the Lena and Behring Strait.

NEWS, dated February 23, have just been received at Vienna from the Hungarian Expedition travelling in China under the leadership of Count Bela Szechenyi. Count Szechenyi, Lieutenant Kreitner, and Herr L. Loczi, started from Sia-an-Sen, and after a very laborious march of 20 days, during which they had to pass several mountain chains measuring more than 3,000 metres in height, finally arriving at Lan-Chan-Sen. The province of Shen-Si, where, as in Shan-si and Konan a famine was raging, showed decay and ruin everywhere; the same state of things prevailed in the province of Kiang-Su. The long rebellion of the last years has left these unenviable traces. The expedition intended to leave for Su-tshou on February 14, on which march they would have to pass the Hoang-ho river.

AT the last meeting of the Berlin Geographical Society the President, Dr. Nachtigal, communicated the latest reports received from the German African travellers. Engineer Schütt has started on his journey into the interior and believes that he has now succeeded in overcoming all the difficulties which at first presented themselves to his further progress towards the East and North; he now intends entering the country of the Adjellengo tribe. Dr. Buchner was detained at Cassenge through the rainy season. He intended leaving for the interior at the beginning of May. Dr. Gerhard Rohlfs has had much to endure from the fanaticism of the natives at Djalo, where he is still staying, and has also been unable to obtain a guide through the Wadai desert on account of the unfriendliness of the Bengasine Government. His companion Dr. Strecker has returned to Bengasi in the meantime in order to attempt to make the Government more favourably disposed towards Dr. Rohlf's undertaking.

ON June 3rd the Dutch North Polar Expedition sailed from Amsterdam on board the "Willem Barends." The ship is equipped with all necessaries for 10 months.

A CARAVAN from Abyssinia has arrived at Marseilles, being destined for the acclimatization garden of Paris. It is composed of 15 men, 4 women, 2 children, 32 camels, 4 oxen, 2 zebras, 4 elephants, 8 ostriches, asses, and horses from Dongola and Abyssinia.

THE Batavian Society of Arts and Science have published in English in a recent volume of their Transactions some curious notes on the Malay Archipelago and Malacca, which have been compiled from Chinese sources by Mr. W. P. Groeneveldt.

NOTES

WE regret to say that although all critical symptoms have disappeared, Sir Wyville Thomson is not regaining strength so fast as was at first hoped. It will be some time still before he can attend to business letters. In the meantime all communications connected with *Challenger* matters should be addressed either to Mr. John Murray, his Principal Assistant, *Challenger* Office, 31, Queen Street, Edinburgh, or his Secretary, Mr. George Leslie, University, Edinburgh.

PROF. A. R. RAMSAY has been elected a Foreign Corresponding Member of the R. Accademia dei Lincei. At the same time Drs. vom Rath and Donders were elected to a similar honour.

PROF. AUGUST KROENIG, the author of "Grundzüge einer Theorie der Gase," died at Berlin on June 5, after a year's illness.

IN the death of Prof. Carl Theodor Ludwig Neubauer, to which we briefly alluded in our last number, German chemistry has lost one of its most accomplished specialists. Neubauer was born at Lüchow in 1830. After a fair high-school education and some experience as an apothecary he entered, at the age of twenty-three, the laboratory of the famous analytical chemist, Fresenius, at Wiesbaden, in the capacity of assistant. In 1856 he commenced his pedagogical career as privat-docent, and received in 1864 a professor's chair. At an early period he became a recognised authority in various branches of analytical, agricultural, and physiological chemistry, and especially in the chemistry of the urine, to which he has always devoted his chief attention. His researches in this department embrace the detection of various normal and abnormal constituents previously unknown, and the elaboration of exact methods for the qualitative and quantitative analysis of urine. The manual of Neubauer and Vogel on this subject, which reached its seventh edition in 1876, is regarded as the most exhaustive and complete work of the kind. The various higher derivatives of the urea group occurring in nature, such as xanthin and kreatin, were also made the base of careful research. Neubauer's investigations into the chemistry of wine have likewise

been productive of valuable results, and his work on this subject, which appeared in 1870, has been successively rendered into English and Italian. No small portion of his time was devoted to the perfection or invention of new general analytical methods, and in this connection mention should be made of his careful, critical reviews of the progress of analytical chemistry, which have formed so important a part of Fresenius' *Zeitschrift für analytische Chemie* since its foundation in 1862. Neubauer was honoured successively by calls to professorships in Zurich, Tübingen, and Erlangen, all of which he declined; preferring the more quiet, if somewhat limited field offered to his activity in Wiesbaden.

THE Council of the Society of Arts have awarded the following medals for papers read during the past session of the Society:—To Mr. Alfred Haviland, M.R.C.S., for his paper on the distribution of disease popularly considered; to Mr. John Holloway for his paper on a new application of a process of rapid oxidation, by which sulphides are utilised as fuel; Mr. Conrad W. Cooke for his paper on Edison's new telephone; Mr. Thomas Wardle for his paper on the wild silks of India, especially Tussah; and Dr. Wm. Wallace, F.R.S.E., for his paper on gas illumination.

MR. JOHN FISKE, whose able work on "Cosmic Philosophy" is familiar to our readers, is just now in England, and has put in the hands of Messrs. Macmillan and Co., for early publication, a volume of essays on Darwinism and other subjects of a kindred nature.

AS our readers know, there are one or two vacant seats in Parliament for which there is already busy competition throughout the country. Sir John Lubbock, in a letter to the *Times*, suggests that one of them be devoted to science. "As the time is approaching," he writes, "when the distribution of the vacant seats will claim the attention of Her Majesty's Government, I would suggest whether one of them might not with advantage be allotted to the Royal Society. The members of that Society are all men eminent in their respective branches; they would form a constituency second to none in the United Kingdom, and would certainly send a representative who would be a valuable addition to the House of Commons. The agricultural, manufacturing, and commercial interests, the military and naval services, and the law are all strong in the House of Commons; literature is represented by the University members; but science, the practical importance of which is daily increasing, has no voice in the deliberation of the nation. The proposal which I venture to suggest would likewise have the merit of introducing some additional variety into our representative system. The alternative would be that there should be one more member for a great borough or a populous county. Lastly, I may add that the constituency, though not large, would be by no means among the smallest in the United Kingdom."

WE are requested to explain that the paragraph in the Astronomer-Royal's report relating to the performance of the Westminster clock, referred to its going during the exceptionally severe weather of the past winter. On the average of the whole twelve months it would appear that the present is the best year but one of the clock's performance, *it having been within one second of true time on* 80 *per cent.* of the days of observation.

ONE of the most interesting novelties in the Berlin Exhibition is the construction of an electrical railway by Siemens and Halske. The electrical power is supplied by a dynamo-electric machine worked by a steam-engine to another dynamo electric machine, which works the wheels of an electric locomotive. The length of the way is 200 metres, the velocity three metres per second; the number of waggons three, and passengers twenty. The same experiment will be tried at the Scientific Exhibition at the Paris Palais de l'Industrie, with Marcel Deprez's motor, which is very promising. A new model has been constructed, weighing seven kilograms, and with twelve Bunsen elements can give a man-power. This model of Marcel Deprez's is exhibiting now at Lille, on the occasion of one of the ascents of the Aëronautical Academy. It is hoped that it will have force enough to work an aërial helix for ascending and descending without any sacrifice of ballast and escape of gas.

AN interesting ceremony has just taken place at Paris. The pupils of the École Centrale, which was founded at Paris in 1829 by MM. Dumas, Lavallè, Perdonnet, and a number of engineers for promoting education in practical science, has celebrated the fiftieth anniversary of that event. The new institution was so prosperous that a few years ago it was purchased by the Government and made a public institution. It would be difficult to give an idea of the number and importance of the positions occupied by the pupils of the École Centrale in French industry. It may be said without any exaggeration that they have been employed in the construction of almost every railway in France and perhaps on the Continent. Most of the French jurymen to the several international exhibitions have been educated there. M. Dumas, who enjoys excellent health, and may expect as long a career as his friend, M. Chevreul, is the only founder alive, and consequently was the hero of the celebration. On June 20 he was received at the Hotel of the Rue Couture St. Gervais, where the school is situated, by the members of the Conseil de Perfectionnement, directors and pupils, who offered him a testimonial of gratitude. On June 21 a great meeting was held at the Trocadero, in the large hall, under the presidency of M. Tirard, Minister of Agriculture and Commerce, M. Dumas sat at his right. M. Dumas, who is an eloquent and powerful speaker, delivered a most impressive address. He spoke on the obstacles which the founders met with, and after having explained how they had managed to win success, he exclaimed, "We had faith, and you proved that we were right in having it." At seven o'clock the pupils met at the Continental Hotel, having invited MM. Dumas, de Lesseps, Boisson, vice-president of the Chamber of Deputies, and a number of leading railway engineers, and others.

THE memory of the great Swedish botanist Linné (Linnæus) is about to be honoured in a fitting manner by his countrymen. In the State Budget for 1880 a sum of 80,000 Swedish crowns is set aside for the purchase of the Hammarby estate, near Upsala, which originally belonged to Linné, as well as of a quantity of furniture he [once] possessed. This new Linné Museum will be placed under the superintendence of the Rector of Upsala University.

AT the last meeting of the Geological Society, Prof. Prestwich announced that the next International Geological Congress will be held at Bologna in September, 1881, and that the President of the Committee, Prof. Capellini, had written, requesting co-operation on the part of the Geological Society and its Fellows. Among the matters which would be brought forward at this Congress would be the unification of geological nomenclature and the symbols used in geological mapping.

A ZOOLOGICAL station similar to that at Naples is about to be established at Messina.

WHAT with its museums and learned societies, the Berlin *Times* correspondent writes, Berlin is fast becoming a highly-favourable centre for the study of ethnology. Some time ago a tribe of Esquimaux attracted large crowds to their quarters in the Zoological Gardens. A family of Patagonians is waiting impatiently to be introduced by Prof. Virchow to the Anthropological Society to-morrow evening, while the latest phase of

enterprise in this respect is nothing more nor less than the importation of half-a-dozen live Zulu Caffres!

DR. ELLIOTT COUES'S Bibliographical Appendix to his "Birds of the Colorado Valley" has proved, the New York *Nation* states, the occasion of one of the highest compliments paid of recent years to American science. A memorial has been addressed to him, signed by Prof. Flower, Huxley, Darwin, Mivart, Wallace, Gould, Sclater, Günther, Newton, and numerous other eminent English zoologists, declaring his special fitness to undertake a complete Bibliography of Ornithology, and urging the importance—the indispensableness, in fact—of his visiting the older European libraries in order, for the non-American portion, to consult every work mentioned at first hand. They express the hope that the same official liberality which has permitted Dr. Coues to remain in Washington for the prosecution of his bibliographical labours, will grant him leave of absence and provide the means for carrying out the wishes of the memorialists; and they promise him a warm welcome to England and every assistance in their power. Such a call, the *Nation* thinks, ought to be irresistible, and has every reason to believe that it will be heeded.

THE fine collections, consisting mainly of insects, of Dr. A. Boucard, the results of many years' gathering from all parts of the world, are for sale.

PROF. DUBOIS-REYMOND showed in 1859 that the polarisation of amalgamated zinc electrodes in aqueous solution of zinc sulphate was, with use of very weak polarising currents, extremely small, and he called such a combination "unpolarisable." This mere approximation seems to have been since misapprehended, and it has been quite overlooked that the non-polarisability is quite lost with increasing strength of current. In experiments lately made by Herr H. F. Weber, in order to test the laws of hydro-diffusion (*Vierteljahrsschrift der naturf. Ges. zu Zurich*, vol. xxiii.), it has appeared that between amalgamated zinc plates in zinc sulphate solution, a very definite polarisation occurs, and may even be employed as a method of measurement for the progress of the diffusion. This polarisation, however, is not the consequence of electrolytic processes at the electrodes, but of changes of concentration in the layers of zinc sulphate solution in contact with the electrodes, produced by passage of the ions. A sample experiment with amalgamated zinc plates, not placed vertically opposite each other, but horizontally, one over the other, proves the correctness of this assertion.

THE Scinde *Civil and Military Gazette* describes a remarkable hailstorm that burst over Hala on May 8. The storm, we believe, was purely local. It commenced about four o'clock in the afternoon, coming up from the north-west with a strong wind and preceded by a heavy dust-storm. On the first burst the hailstones were, in form, flattened cones, with a central belt of snow-like ice and outer belts of clear ice. After the first fall of hail and rain the storm swept on to the south. There was a short lull, when the storm, working apparently in a circle, again broke over Hala, this time coming up with the wind from the south. Thunder and lightning were now continuous, the thunder, in fact, never ceasing for an instant, and a fall of enormous hailstones took place. These, unlike those of the first fall, were spherical in shape, snow-like in appearance, and in size larger than the largest marble—one, whose diameter was estimated, being an inch and a half across—as large, that is, as an ordinary hen's egg. For some time after the storm the ground was thick and white with the monstrous hailstones; except under trees, where beds of leaves and branches lay, broken and beaten off from above. The storm continued from first to last for about one hour and a half, and went off towards the north-east.

THE *Henry Giffard* captive balloon has been inspected by the public authorities of Paris, and opened to the public for ascents.

IN a recent medical report from Chinkiang, on the Yangtsze-kiang, in the neighbourhood of which there are immense depôts of salt, Dr. A. R. Platt mentions that he has observed a form of skin disease, presenting all the essential symptoms of ecthyma, yet with others that do not properly belong to that affection, and all so aggravated as to make the variety unique in his experience. It appears to be peculiar to workers in salt, judging from the four cases Dr. Platt has seen, all of whom were females, and all engaged in salt smuggling. They did not hesitate to attribute their condition to their daily habit of carrying large quantities of salt in girdles next the skin, so as to be concealed by their clothing, though, as the eruption first appeared on the hands, they were more inclined to lay it down to the preparation of the packages than to the transportation, and informed Dr. Platt that it was quite common among the people at the salt stations whence they procured their illicit supplies. Dr. Platt in his report furnishes a detailed account of the symptoms exhibited in the cases referred to, and of the line of treatment which he adopted with very satisfactory results.

THE Municipal Council of Paris has adopted a proposal made by M. de Villiers, Chief Engineer of Ponts-et-Chaussées, for establishing at the Trocadero a stone which will be the zero point of levelling for Paris and the Seine Department. It is stated that the Minister of Public Works will order such a stone to be erected in the chief city of each department. All these stones will be related to each other by the Bourdaloue levelling which was made many years ago, and which takes for zero the mean level of the Mediterranean at Marseilles; this last is supposed, of course, as invariable.

THE French Minister of Agriculture has published a report on the agricultural educational institutions of France, which shows an immense variety. The head establishment is the École Supérieure of Agriculture at the Conservatoire des Arts et Métiers. Next to this institution are the regional schools of agriculture as at Grignon and several other places. A number of special subjects have schools devoted to them, as the veterinary school at Alfort, schools of gardening at Versailles, schools of draining and irrigation in Brittany; a school of pisciculture has been established at Huningue, which was lost to France with Alsace; there are also schools for sheep-rearing, vine-growing, &c. The Vincennes farm and some others are devoted to experimental agriculture. Farmers' schools are located in several parts of the country, and kept by private individuals at their own expense, with a subsidy from townships or departments for training young men in several agricultural specialties. We may also consider as a part of these institutions the School of Arboriculture in the Luxembourg, and the School of Insectology in the same garden; although they have no registered pupils, they have lecturers and museum and experimental grounds at their disposition.

A TRANSLATION of Fau's "Anatomie Artistique," by Dr. Carter Blake, of Westminster Hospital, will shortly be published by Messrs. Baillière, Tindall, and Cox.

A RUSSIAN paper gives an account of a plague of locusts near Elisabetpol, which forced a detachment of troops on the march to retrace their steps. They settled so thick on the soldiers' faces, uniforms, and muskets, that the major, driven to desperation, ordered firing at them for half an hour, but this produced no effect, and a march back was ordered. The swarm covered an area of thirty-five square versts.

A SWARM of butterflies passed over Worms on the 13th and 14th, proceeding from north-west to south-east.

A JAPAN paper mentions a curious instance of Japanese thrift at Osaka. The paper made at the mill there is mostly manufactured from blue rags, and the water in which they are boiled has hitherto only poisoned the watercourses; henceforth it is to be saved and the indigo extracted from it.

THE Manchester people have entered a fresh protest against centralisation by the publication of the *Manchester Magazine*, No. 2 of which lies before us, and devotes a fair proportion of its space to articles in science. Mr. L. H. Grindon writes on the art of distinguishing trees, and Mr. Angell on the Manchester Science Lectures. Prof. Osborne Reynolds writes on the Manchester Philosophical Society, and there are articles on Star-gazing, the Phonograph, the Weather, &c. Indeed the bulk of the magazine is scientific.

THE University Library at Strassburg has, according to the latest news, now reached the total of 470,000 volumes.

WE have received a very favourable Report of the Auckland (N.Z.) Institute for 1878-9. A considerable number of papers bearing on the natural history of New Zealand have been read during the session.

THE additions to the Zoological Society's Gardens during the past week include two Macaque Monkeys (*Macacus cynomolgus*) from India, presented respectively by Mr. G. T. Close and Miss E. Cattlin; a Garnett's Galago (*Galago garnetti*) from East Africa, presented by Mr. F. W. Barff; two African Civet Cats (*Viverra civetta*) from Africa, a Kinkajou (*Cercoleptes caudivolvulus*) from Demerara, presented by Lieut. M. B. Salmon, Indian Staff Corps; two Egyptian Gazelles (*Gazella dorcas*) from Egypt, presented by Commander J. Pratt, s.s. *Java*; a Persian Gazelle (*Gazella subgutturosa*) from Persia, presented by Mr. C. H. Watts; three Hyacinthe Porphyrios (*Porphyrio hyacinthinus*) from West Africa, two Egyptian Kites (*Milvus ægyptius*) from Egypt, presented by Mr. A. Bells; a greater Sulphur-Crested Cockatoo (*Cacatua galerita*) from Australia, presented by Mr. J. W. Taylor; a Slender-billed Cockatoo (*Licmetis tenuirostris*) from South Australia, presented by Mr. Geo. Wood; a Ring-necked Parrakeet (*Palæornis torquatus*) from India, presented by Mr. E. F. Carey; four Australian Wild Ducks (*Anas superciliosa*) from Australia, presented by Messrs. A. H. Jamrach and Charles Rice; two Pied Wagtails (*Motacilla yarrelli*), British Isles, presented by Mr. A. F. Wierner; a Common Badger (*Meles taxus*), British Isles; a Ceram Lory (*Lorius garrulus*) from Moluccas, an American Robin (*Turdus migratorius*) from North America, a West African Python (*Python sebæ*) from West Africa, a Reticulated Python (*Python reticulatus*) from Molucca, eleven Spotted Salamanders (*Salamandra maculosa*), European, deposited; a Beech Marten (*Martes foina*) from Russia, a Brazilian Tanager (*Ramphocælus brasilius*) from Brazil, twenty Spotted Salamanders (*Salamandra maculosa*), European, purchased; a Collared Fruit Bat (*Cynonycteris collaris*), two Jameson's Gulls (*Larus jamesoni*), bred in the Gardens.

THE NATURAL HISTORY MUSEUM

THE following memorial has been recently presented to the Earl of Beaconsfield:—

To the Right Hon. the First Lord of the Treasury

My Lord,—In accordance with a resolution adopted by the General Committee of the British Association for the Advancement of Science at their last meeting, the Council of the Association beg leave to call your attention to the following circumstances.

1. In their fourth Report, presented to Parliament in 1874, the Royal Commission on Scientific Instruction and the Advancement of Science, having fully considered the present state of the Natural History Departments in the British Museum, and taken evidence thereon from the principal scientific authorities of the country, state that they have come to the conclusion "that the objections to the present system of government of the British Museum by a Board of Trustees as at present constituted, so far as relates to the Natural History Collections, are well founded, and that they have been unable to discover that the system is attended by any compensating advantages." They, therefore, recommend:—"(1) That the occasion of the removal of these collections to the new buildings now being erected at South Kensington for their reception, be taken advantage of to effect a change in the governing authority and official administration of that division of the Museum. (2) That a director of the National Collections should be appointed by the Crown, and should have the entire administration of the establishment, under the control of a Minister of State, to whom he should be immediately responsible, and that the keepers of collections should be responsible to the director. That the appointments of keepers and other scientific officers should be made by the Minister, after communication with the Director and with the Board of Visitors (hereinafter referred to). And that the Director should prepare the estimates, to be submitted, after consultation with the Board of Visitors, for the approval of the Minister. (3) That the present superintendent be the first director. (4) That a Board of Visitors be constituted. That the Board be nominated in part by the Crown, in part by the Royal and certain other scientific Societies of the metropolis, and, in the first instance, in part also by the Board of Trustees; the members to be appointed for a limited period, but to be re-eligible; and that the Board of Visitors should make annual reports to the Minister, to be laid before Parliament, on the condition, management, and requirements of the Museum, and should be empowered to give him advice on any points affecting its administration."

2. Exactly the same view as to the desirability of effecting a change in the government of the Natural History Collections was taken in a memorial presented to the then Chancellor of the Exchequer in 1866, and signed by the Presidents and other well-known members of the Royal, Linnean, and Zoological Societies, a copy of which is appended hereto.

3. Notwithstanding these expressions of opinion, in which nearly all the leading naturalists of the day fully concur, an Act was passed at the close of the last session of Parliament by which the Trustees of the British Museum have been authorised to transfer the Natural History Collections into the new building at South Kensington, without making any change whatever in the present mode of their administration.

4. The Council of the British Association feel that it is not necessary for them to press upon the Government the arguments for the changes in the administration of the Natural History Collections which have been so amply stated by the Commissioners in the Report above-mentioned. The Council think it sufficient to call the attention of the Government to the fact that the provisions of the act are directly at variance with the recommendations of the Royal Commissioners.

5. As, however, a fresh application to Parliament will be necessary in order to defray the expense of the removal of the Natural History Collections from their present situation to South Kensington, the Council of the British Association beg leave to point out to H.M. Government that the question of the administration of the Natural History Collections is one of the utmost importance as regards the future progress of Natural History in this country, and to urge upon them to take the opportunity which will thus present itself of effecting the alterations in the mode of administration of the Collections recommended by the Royal Commission. We have the honour to be, your Lordship's most obedient servants,

The Council of the British Association
for the Advancement of Science

Signed, for the Council, W. SPOTTISWOODE, *President*
DOUGLAS GALTON, P. L. SCLATER, *Secretaries*

COPY OF A MEMORIAL PRESENTED TO THE RIGHT HON. THE CHANCELLOR OF THE EXCHEQUER

To the Right Hon. the Chancellor of the Exchequer

London, May 14, 1866

SIR,—It having been stated that the scientific men of the Metropolis are, as a body, entirely opposed to the removal of the Natural History Collections from their present situation in the British Museum, we, the undersigned Fellows of the Royal, Linnean, Geological, and Zoological Societies of London, beg leave to offer to you the following expression of our opinion upon the subject:—

We are of opinion that it is of fundamental importance to the progress of the natural sciences in this country that the administration of the National Natural History Collections should be separated from that of the Library and Art Collections, and *placed under one officer, who should be immediately responsible to one of the Queen's Ministers*,

We regard the exact locality of the National Museum of Natural History as a question of comparatively minor importance, provided that it be conveniently accessible and within the Metropolitan District.

GEORGE BENTHAM, F.R.S., F.L.S., F.Z.S.
WILLIAM B. CARPENTER, M.D., F.R.S., F.L.S., F.G.S.
W. S. DALLAS, F.L.S.
CHARLES DARWIN, F.R.S., F.L.S., F.Z.S.
F. DUCANE GODMAN, F.L.S., F.Z.S.
J. H. GURNEY, F.Z.S.
EDWARD HAMILTON, M.D., F.L.S., F.Z.S.
JOSEPH D. HOOKER, M.D., F.R.S., F.L.S., F.G.S.
THOMAS H. HUXLEY, F.R.S., V.P.Z.S., F.L.S., F.G.S.
JOHN KIRK, F.L.S., C.M.Z.S.
LILFORD, F.L.S., F.Z.S.
ALFRED NEWTON, M.A., F.L.S., F.Z.S.
W. KITCHEN PARKER, F.R.S., F.Z.S.
ANDREW RAMSAY, F.R.S., V.P.G.S.
ARTHUR RUSSELL, M.P., F.R.G.S., F.Z.S.
OSBERT SALVIN, M.A., F.L.S., F.Z.S.
P. L. SCLATER, F.R.S., F.L.S., F.Z.S.
G. SCLATER-BOOTH, M.P., F.Z.S.
S. JAMES A. SALTER, M.B., F.R.S., F.L.S., F.Z.S.
W. H. SIMPSON, M.A., F.Z.S.
J. EMERSON TENNENT, F.R.S., F.Z.S.
THOMAS THOMSON, M.D., F.R.S., F.L.S.
H. B. TRISTRAM, M.A., F.L.S.
WALDEN, F.Z.S., F.L.S.
ALFRED R. WALLACE, F.R.G.S., F.Z.S.

SCIENTIFIC SERIALS

THE *Archives des Sciences physiques et naturelles* (May, 1879) contain the following more important papers:—Geological review of Switzerland for the year 1878, by M. Ernest Favre (continuation).—On the lake-dwellings of the Swiss lakes, by Dr. F. A. Forel.—On the rotatory power of isocholesterine, by E. Schulze.—On the existence in a gaseous state of nitrous anhydride and nitrous acid, by G. Lunge.

The Rivista Scientifico-Industriale (No. 10, 1879) contains the following articles:—On a new instrument to study microseismic phenomena, by Prof. Giovanni Mugna.—On the regress canals for the filling of ponds, by Francesco Cagnacci (3 plates).—On the present state of Mount Vesuvius, by Prof. Semmola.—On the blue colours in manufacture of porcelain, by V. Joclet.

SOCIETIES AND ACADEMIES

LONDON

Linnean Society, June 5.—Prof. Allman, F.R.S., president, in the chair.—Attention was called to an article on Cinchona in India, by Mr. J. E. Howard. *Calisaya Ledgeriana* is shown to yield excellent results, as much as 10 per cent. of quinine, and of excellent quality, being obtained.—Prof. Parker read a memoir on the structure and development of the skull in the Urodelous amphibia. Several forms are here worked out, the Spotted Salamander serving as a type. Some of the so-called skin bones appear early, other investing bones appear later, and the investing cartilaginous roof of the nose comes after the ear capsule cartilages. Some Urodela show a stapes absent in Ceratodus and Lepidosiren. The transformations of the Anoura are carried on in the plastic larva and young to a greater extent than in the Urodela.—A paper on the Lichens collected during the English Polar Expedition of 1875-76, by Prof. Fries, of Upsala, was communicated by Sir J. D. Hooker. In Dr. Hayes's Arctic journey lichens probably were not brought away from a more northerly position than 78° N. lat., but Julius Payer, in the German Expedition, with certainty obtained specimens at Cape Fligely, 82° 5′ N. lat. With the exception of these last, but three species of lichens hitherto have been published as found beyond 81° N. lat. Thus considerable interest is attached to those got under Capt. Sir G. Nares by Capt. Feilden, of the *Alert* and Mr. Hart of the *Discovery*. As these vessels wintered in different quarters, the localities where the lichens were obtained correspondingly are more numerous, thus adding to their value as indicative of vegetable life in the frozen regions. Mr. Hart, got his at thirteen stations, Discovery Harbour, 81° 42′ N. lat., being the most northern; Capt. Feilden records twelve stations, Westward Ho Valley, 82° 41′ N. lat. being the limit. But Lieut. Aldrich gathered *Gyrophora cylindrica* on the shore of the "Palæocrystic Sea," the northernmost spot trodden by man, viz., Cape Columbia, 83° 6′ 30″ N. lat. Prof. Fries notes that the so-called "fruticolous" and "foliaceous" lichen species are feebly represented, doubtless accounted for by the severe climate, but seemingly at variance with the presence of musk oxen; added to which the reindeer moss is absent. This anomalous circumstance of the presence of large ruminants and deficiency of their usual lichen food, Capt. Feilden explains by stating that the musk ox in Grinnel Land does not feed on lichens, but on mosses and grasses. The same officer has also pointed out that the lichen growth curiously enough increased in size of species with increase of altitude. Prof. Fries concludes that, without the least credit being given to an open Polar sea (existing, no doubt, only in fancy), lichen vegetation may exist at the very Pole, if only land be there, and occasionally free from snow or ice. Among the series obtained in the Expedition, save a very few, all the forms of lichens of over 100 are already known. The abstract of a fourth contribution to the Mollusca of the *Challenger* Expedition, by the Rev. R. Boog Watson was read. This dealt with the Trochidæ and Turbinidæ.—The Secretary also read a communication on a remarkable new form of Helvella, this fungus being described by Mr. W. Phillips.—Mr. C. B. Clarke summarised a lengthened memoir by him, viz., a "A Review of the Ferns of North India." He showed that many of the localities given by Dr. Wallich, and doubtfully received by botanists were doubtless correct.—Mr. A. D. Michael was elected a Fellow of the Society.

Zoological Society, June 17.—Prof. W. H. Flower, F.R.S., president, in the chair.—Mr. Sclater exhibited a skin of *Ara glauca*, from Mr. Boucard's collection, obtained at Corrientes, and stated that having compared it with the *Ara* now in the Gardens, purchased in June, 1860, and hitherto named *A. glauca*, he had come to the conclusion that the living bird belonged to the allied form *Ara leari*.—Prof. Flower called attention to the skull of the female sea-lion, which had lately died at the Southport Aquarium, and pointed out that it belonged to *Otaria gillespii*, and not, as had been supposed, to *Otaria stelleri*.—Mr. C. G. Danford exhibited and made remarks on some remarkable antlers of deer, which he had obtained during his recent journey in Asia Minor.—Prof. Newton exhibited skins of some rare species of birds obtained by Mr. Edward Newton, C.M.Z.S., in Jamaica.—Mr. F. D. Godman exhibited and made remarks on a drawing of the manatee by Mr. Wolf, taken from the specimen lately living in the Westminster Aquarium.—Hans, Graf von Berlepsch, exhibited and made remarks on the skins of two varieties of the long-tailed titmouse (*Mecistura caudata*), which occurred near Cassel, in Germany, one of which appeared to be the same as the British form of this bird.—Dr. J. Murie read a paper on the manatee, containing the results of his examination of the specimen which was lately living in the Westminster Aquarium. The peculiar attitudes assumed by the animal in life, the great mobility of the upper lip, and the occasional use of the limbs in feeding were noted. As regards the anatomy, the chief points dwelt on were the shape of the brain and its suppressed convolutions. The vexed question of the number of the cervical nerves and their distribution was also discussed.—A communication was read from Mr. A. H. Garrod, on the brain and on other points in the structure of the adult male hippopotamus, which was presented to the Society by the late Viceroy of Egypt, in 1850, and which died in the Society's gardens in March, 1878.—A second communication from Mr. Garrod contained a note on the mechanism of respiration, as well as of the retraction of the head and limbs in certain chelonia.—Dr. Gwyn Jeffreys communicated the second part of his work on the mollusca of the *Lightning* and *Porcupine* Expeditions, embracing the families from *Anomiidæ* to *Arcidæ*. The number of species noticed was 100, of which 4 were new to science, and 15 were hitherto unfigured. Particulars were given of the geographical and geological distribution of all the species, and their synonymy was discussed. Some species of *Leda* and *Malletia* were Sicilian fossils of the pliocene formation, and had not been previously known as recent or living. These species

occurred at great depths, a fact which showed that the sea-bed in that part of the Mediterranean had been considerably raised since the tertiary epoch.—Mr. Edward R. Alston read a note on the *Acanthomys leucopus* of Gray, showing that it does not belong to the genus *Acanthomys* but to *Mus* proper. As the name *leucopus* is pre-occupied in the latter genus, he proposed to call the species *Mus terræ reginæ*.—Mr. W. L. Distant read a paper on the African species of Lepidoptera of the genus *Papilio*. A new species from Magilia, East Africa, was described, and the name of *Papilio hornimani* was proposed for it.—A communication was read from the Count T. Salvadori, C.M.Z.S., containing further particulars of the new Pheasant from Western Sumatra which he had recently described as *Acomus inornatus*.—Messrs. Godman and Salvin gave an account of some hitherto unrecorded diurnal lepidoptera, obtained by the Rev. George Brown in Duke of York Island and New Ireland, together with descriptions of some apparently new species.—A communication was read from Mr. F. Jeffrey Bell, being the second of the series of his observations on the characters of *Echinoidea*. The present paper contained an account of the species of the genus *Tripneustes*.—Messrs. Sclater and Salvin read a paper on the birds of Bolivia, based principally upon an examination of the specimens obtained by Mr. Buckley during two expeditions into that country.

Geological Society, June 11.—Prof. Joseph Prestwich, F.R.S., vice-president, in the chair.—Noel W. Rudstone Read, was elected a Fellow; and M. Edouard Dupont, of Brussels, Dr. Franz von Kobell, of Munich, and Dr. Emile Sauvage, of Paris, Foreign Correspondents of the Society.—The following communications were read:—On a mammaliferous deposit at Barrington, near Cambridge, by Rev. O. Fisher, F.G.S. The gravel in which these remains were found is about 20 feet above the alluvial flat by the River Rhee, and is evidently post-glacial. The gravel contains some of the ordinary land and fresh-water shells, but not *Cyrena* or *Unio*. Remains of the following mammalia have been found:—*Ursus spelæus, Meles taxus, Hyæna spelæa, Felis spelæa, Cervus megaceros, elephus*, and another, *Bos primigenius, Bison priscus, Hippopotamus major, Rhinoceros leptorhinus, Elephas antiquus* and *primigenius*, with a worked flint, almost certainly from the same deposit. The author considers the abundance and admixture of these remains due to the locality having been a sort of eddy or pool in the old river. The remains are described, and the rest of the paper is occupied with a correlation of the gravel with others in the adjoining district, and a consideration of the physical conditions under which it was deposited.—Further discoveries in the Cresswell Caves, by Prof. Boyd Dawkins, F.R.S., and the Rev. J. M. Mello, F.G.S., with notes on the mammalia by the former. This paper contained the account of digging-operations carried on in one of the smaller caves of the Cresswell Crags, known as Mother Grundy's Parlour. The authors described the occurrence in the red clay and ferruginous sand of this cave of bones of hippopotamus and the leptorhine rhinoceros, proving the existence of these animals in the wooded valleys of the basin of the Upper Trent at the time of the accumulation of those deposits; while at the same time, so far as the evidence goes, there was an absence of palæolithic man, of the reindeer, and of horses, while hyænas were abundant. In a subsequent period, represented in all the caves by the red sand, the mammoth, woolly rhinoceros, horse, and reindeer inhabited the vicinity, and were subject to the attacks both of hyænas and of human hunters, whose quartzite implements prove them to belong to the same people whose traces are found in the river-deposits. In the breccia and upper cave-earth of the larger caves the existence of the palæolithic hunter is evidenced by flint implements, resembling those of Solutré, accompanied by implements of bone and antler. Associated with these was the incised figure of a horse described in a former paper. The authors finally dwelt briefly upon the characteristics of the caves in prehistoric and historic times, and indicated some of the anthropological points of interest connected therewith.—On the pre-Cambrian rocks of Shropshire, part 1, by C. Callaway, F.G.S.—On the occurrence of a remarkable, and apparently new mineral in the rocks of Inverness-shire, by William Jolly, F.R.S.E., H.M. Inspector of Schools, and J. Macdonald-Cameron, Fel. Inst. Chem., F.C.S. In this paper the authors refer to a blue mineral of a somewhat remarkable character, noticed at Englishton Moor and neighbourhood, distant westwards, from Inverness, about 5 miles, where the mineral occurs in scattered blocks. It has since been noticed at Moniack Burn, Reelig Glen, and South Clunes Farm, all in the same direction, but distant from Inverness about 10 miles; also near Dochfour House, at the north end of Loch Ness, close by Dochgarroch Lock of the Caledonian Canal. In colour and general appearance this mineral resembles crocidolite, but analyses point to its being more nearly related to ægirite, a member of the amphibole group, which has the general formula $Si3(\frac{1}{3}\overset{III}{R} + R^3)$. The mean of several analyses shows it to have the composition $6SiO_2$, Fe_2O_3, $2MgO$.

Physical Society, June 14.—Prof. W. G. Adams in the chair.—New Members: Donald Macalister, B.A., and Mr. St. George Lane Fox.—Prof. Macleod described a plan for suppressing the induction disturbances in a telephone circuit. It is known that a secondary battery composed of metal plates and sulphuric acid allows weak currents to pass while stopping those of high tension. Prof. Macleod inserted a secondary battery of platinum plate between the line and the telephone, but this stopped both the induction and the vocal currents. When platinum wires were substituted for the plates, however, the induction-currents were stopped, while the vocal currents could be feebly heard.—Dr. O. J. Lodge exhibited his new reversing key for electrometer work, which is preferred to the ordinary forms as giving a high insulation, small capacity, and not requiring the hand to approach close to it to work it. It consists of four platinum wires arranged in pairs crossing one another, one pair crossing between the other two. These are the terminals and contact pieces of the key. The middle pair are supported by an endless silk thread which runs on two pulleys, one of which is fitted with a handle. On turning the handle to right or left the two middle wires are brought into contact with one or other of the two outer wires, and the current reversed at will. The whole is inclosed in a metal box.—Mr. J. F. Moulton then demonstrated the results of the experiments of Mr. Spottiswoode and himself on the sensitiveness of electric discharges in vacuum tubes. These experiments were undertaken to find the cause of the luminous layers or strata in the discharge, a Holtz machine being employed. It was observed that when feeble currents were drawn from the machine, the discharge could be depressed by laying the finger on the tube, and this depression always occurs with intermittent currents, therefore the feeble currents form a continuous current Holtz discharge themselves, like intermittent currents, by reason of their feebleness. This sensitiveness of the discharge to the approach of the finger was found to be due to the conductivity and electric capacity of the hand. Electricity opposite in kind to the discharge is induced on the finger, and streaming upon the tube, neutralises part of the discharge therein. This effect was also shown by means of tinfoil rings round the tube. An intermittent current is of course capable of this static induction on neighbouring conductors. The luminous discharge in a vacuum-tube consists of a bright sharp glow at the negative terminal, followed by a dark space, then a hazy bluish light at the positive pole. The striæ or layers in these sensitive tubes merely repeat this appearance. They can be artificially produced by placing the fingers, or rings of metal, at intervals along a tube conveying an amorphous discharge; for in this case the induced electricity discharging itself from the fingers, breaks up the amorphous discharge into dark and bright layers. In these stratified discharges the electricity appears to travel *per saltum*, or by stepping-stones, as one may say, and the glow seems to be a molecular structure, a view which is supported by Mr. Crookes's experiments. A negative discharge from the finger produces a dark space in the tube discharge, and a positive one a bright line; therefore one can tell the kind of discharge passing in a tube by laying a finger on it. If the same pole be brought to both ends of a tube a discharge will still take place from each end, and there will be a dark space in the middle, the electricity here seeming to turn back again the way it came. The discharge from a pole through a vacuum tube would therefore appear to be not akin to conduction, but to a disruptive discharge. It is a leap in the dark, and the phenomena observed are due to the gaseous nature of the medium. These experiments point to the possibility of completing a circuit by positive electricity alone. Prof. Guthrie suggested that by combining vacuum-tubes with the conduction-balance of Prof. Hughes it might be possible to get an optical balance for measuring inductive capacity.—Dr. Henry Draper, of New York, who is now on a visit to England, then addressed the meeting on his alleged

discovery of oxygen in the sun by bright lines in the solar spectrum. He said that hitherto he had not been able to find these lines projecting from the limb of the sun, like hydrogen, and his impression is that oxygen resides lower than the reversing layer. He had lately been extending the dispersion of the spectrum of terrestrial oxygen, and from a light of maximum intensity of one-candle power had now got a dispersion of eighty inches from A to O. He exhibited two of the original negatives of the solar spectrum showing the bright lines. Mr. J. Norman Lockyer congratulated solar science on having so able a worker as Dr. Draper, and remarked that if Dr. Draper proved his case for even two or three O lines it would be sufficient, considering the variability of the spectrum of matter under different physical conditions. He also alluded to the traces of carbon which he himself had found in the sun by the dark flutings in the spectrum. Dr. Draper said he did not see why carbon should not give both bright and dark lines.—Mr. Scott exhibited a number of coloured photographs done after the method of M. Albert, of Munich.

Statistical Society, June 17.—Dr. William A. Guy, F.R.S., read a paper on tabular analysis. Dr. Guy began his paper by stating that its chief object was to call attention to a particular form of tabular analysis first proposed by Dr. Tweedy John Todd, of Brighton. Dr. Guy in the course of his paper mentioned briefly the inquiries to which he had applied Dr. Todd's method as modified by himself. He had made use of it in the inquiry entrusted to him in 1862 into the effects of the poison known as emerald-green when used in the arts; in comparing the statements made in the four gospels; in contrasting the evidence of different witnesses in the Tichborne case; in inquiries relating to poisoning by arsenic and strychnine; and in comparing poisoning by strychnine with tetanus. The general use of tabular forms for purposes of illustration was largely illustrated by various specimens which Dr. Guy had used in his lectures at King's College, and former papers read before the Society. They had reference to crime, to fluctuation in recurrent events, &c., &c. The author finished his paper by stating that he believed he did not attach undue importance to tabular analysis, or the discovery of truth by means of tabular forms, as distinct from tables of record and tables of illustration, when he anticipated from their intelligent and more extended use, not only greater accuracy of statement and completeness of description, but important discoveries also. The Statistical Society was dealing with a vast array of facts, into which scientific methods and scientific treatment are ever introducing more and more of order, more and more of light.

PARIS

Academy of Sciences, June 16.—M. Daubrée in the chair.—The following papers were read:—Transmission of the hour at Paris Observatory to commercial ports for regulation of chronometers, by M. Mouchez. He is hoping to accomplish this once a week, at least, by telegraph; but the expense is at present a difficulty.—On the development of the perturbative function where, the eccentricities being small, the mutual inclination of the orbits is considerable, by M. Tisserand.—On the spherical regulating spiral of chronometers, by M. Phillips.—Observations on M. Lamarsky's note on Stokes's law, by M. E. Becquerel. The phenomena of fluorescence do not depend on a simple change of refrangibility of luminous rays falling on a body (as M. Lamarsky seemed to say), but on a complete transformation of the vibratory movement. The illuminated body gives out, by an action proper to it, light whose composition cannot be connected in a simple way with the nature of the incident vibrations.—On the density of vapour of bisulphydrate of ammonia, by M. Sainte-Claire Deville. He gives details of this from old laboratory notes (having been reminded of the omission by MM. Engel and Moitessier).—Determination of the height of mercury in the barometer at the equator; amplitude of diurnal barometric oscillations at different stations in the Cordilleras (continued), by M. Boussingault. His observations at Bogota did not confirm Mutis's assertion of a lunar influence on the barometric heights, though a very delicate instrument was used. He found the average monthly heights greatest in June and July, least in December and January (when the earth is nearest the sun). He gives meteorological details regarding Antisana Farm, which is at an altitude of 4,100 metres.—On the last modifications made in the sluice of Aubois, and on the means used in it to deaden the percussions of the movable tubes on their seats, by preventing their rebound, by M. De Caligny.—M. Daubrée presented the first part of a work entitled "Synthetical Studies of Experimental Geology," being a collection of papers published during the last thirty years.—Observations of the planet 198, discovered at Marseilles Observatory, by M. Borrelly.—On the surface of the wave and the transformation of a pencil, by M. Mannheim.—On the employment of elliptic functions in the theory of the plane quadrilateral, by M. Darboux.—Theorems of indeterminate analysis, by M. Pepin.—Experiments on the resistance opposed by the air to movement of a surface, by M. Saint-Loup. A plate, inclined to the direction of motion, and fixed at the head of a horizontal radial bar, was driven round a vertical axis, a special arrangement being added to measure the resistance. The resistance for a plane surface of 1 square decimetre making angle ϕ with its path is expressed by the formula—

$$P_\phi = 0{\cdot}1768\ (4^{\sin\phi} - 1)\ V(11 + 1{\cdot}061\ V).$$

—On the electric dilatation of the armatures of Leyden jars, by M. Duter. He finds the law verified, which is expressed by the equation $u = \frac{KV^2}{e}$, where u is the increase of volume of the jar, e its thickness, V the difference of potential of its armatures, and K a coefficient characteristic of the apparatus. He considers that electric pressure is not the cause of the phenomenon, but that there is here a new phenomenon of electricity.—On the same subject, by M. Righi. He distinguishes *instantaneous* dilatation, due chiefly to polarisation of the glass, from *persistent* dilatation, not before observed, and due to development of heat; and he thinks it probable that at the same time the polarisation and perhaps also the attraction between the armatures produce in the glass a diminution of thickness.—On the suspension of clouds and their elevation in the atmosphere, by M. Oltramare. He offers a solution based on the idea that each molecule of a cloud is charged with electricity.—On the basic sulphydrates of ammonia, by M. Troost.—On a new natural sulphate of manganese (mallardite), and a new variety of sulphate of iron (luckite), by M. Carnot. These are from the gold and silver mines of Utah.—On the structure of cells of the kidney in the normal state, by M. Cornil. He finds them composed of two substances, the one peripheric and solidified by osmic acid, the other central, containing granulations and the nucleus of the cell.—Action of electric currents on the muscles of the claw of the crayfish, by M. Richet. Excited directly by strong induced currents, the muscle shows a very prolonged contraction, the duration of which is proportional to the intensity of the stimulus.—On the systematic position of Volvocineæ, and on the limits of the vegetable and animal kingdom, by M. Maupas. He agrees with Cohn and others in classing Volvocineæ among the algæ, with Palmellaceæ, &c.—Influence of media on the structure of roots, by M. Mez.—On a migration of butterflies of the species *Vanessa cardui*, observed at Angers on June 10 last, by M. Decharme.—On some modifications in the apparent colours of flowers by the electric light, by M. Hugo. Such changes were noticed in *Nedularium* and *Caladium*.

CONTENTS